MACKENZIE VALLEY PIPELINE INQUIRY

IN THE MATTER OF APPLICATIONS BY EACH OF
(a) CANADIAN ARCTIC GAS PIPELINE LIMITED FOR A RIGHT-OF-WAY THAT MIGHT BE GRANTED ACROSS CROWN LANDS WITHIN THE YUKON TERRITORY AND THE NORTHWEST TERRITORIES, and
(b) FOOTHILLS PIPE LINES LTD. FOR A RIGHT-OF-WAY THAT MIGHT BE GRANTED ACROSS CROWN LANDS WITHIN THE NORTHWEST TERRITORIES,
FOR THE PURPOSE OF A PROPOSED MACKENZIE VALLEY PIPELINE

and

IN THE MATTER OF THE SOCIAL, ENVIRONMENTAL AND ECONOMIC IMPACT REGIONALLY OF THE CONSTRUCTION, OPERATION AND SUBSEQUENT ABANDONMENT OF THE ABOVE PROPOSED PIPELINE

(Before the Honourable Mr. Justice Berger, Commissioner)

Yellowknife, N.W.T.

November 17, 1975.

PROCEEDINGS AT INQUIRY

Volume 88

ALLWEST REPORTING LTD.,
4299 CANADA WAY,
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ERRATA

BY CANADIAN ARCTIC GAS PIPELINE LIMITED:

Volume 73, October 16, 1975:

p. 10909, l. 12 - "Three-day" should read "Thirty-day".

p. 10899, l. 1 - "Frost heaving" should read "Lensing heave".

APPEARANCES:

Mr. Ian G. Scott, Q.C., Mr. Stephen T. Goudge, Mr. Alick Ryder and Mr. Ian Roland	for Mackenzie Valley Pipeline Limited;
Mr. Pierre Genest, Q.C., Mr. Jack Marshall, and Mr. Darryl Carter	for Canadian Arctic Gas Pipeline Limited;
Mr. Reginald Gibbs, Q.C., Mr. Alan Hollingworth & Mr. John W. Lutes,	for Foothills Pipe Lines Ltd.;
Mr. Russell Anthony & Pro. Alastair Lucas	for Canadian Arctic Resources Committee;
Mr. Glen W. Bell and Mr. Geery Sutton,	for Northwest Territories Indian Brotherhood, and Metis Association of the Northwest Territories;
Mr. John Bayly of Miss Leslie Lane	for Inuit Tapirisat of Canada, and The Committee for Original Peoples Entitlement;
Mr. Ron Veale and Mr. Allen Lueck	for The Council for the Yukon Indians;
Mr. Carson H. Templeton,	for Environment Protection Board;
Mr. David Reesor	for Northwest Territories Association of Municipalities;
Mr. Murray Sigler	for Northwest Territories Chamber of Commerce.

I N D E X

Page

WITNESSES FOR FOOTHILLS PIPE LINES LTD.:

L.W. BOUCHKHOUT
C.W. DREW
Frederic B. CLARIDGE
D.M. DAVISON
Herman VAARTNOU
Norman A. LAWRENCE
James R. TAYLOR
Brian O.K. REEVES
- Cross-Examination by Mr. Ryder 13200
- Cross-Examination by Mr. Goudge 13312

EXHIBITS:

313 Preliminary Archaeological Study, Mackenzie Canada, Second Report 13268

YELLOWKNIFE, N.W.T.
November 17, 1975.

(PROCEEDINGS RESUMED PURSUANT TO ADJOURNMENT)

MR. GIBBS: Mr. Commissioner, we have had some problems securing accommodation for this entire panel and we're hopeful that we will be able to let them go in time for them to catch the 7:50 aircraft tonight. I have spoken to my friend, Mr. Goudge, he says there will be no problem. In the event that there is, the one person who must get away for personal reasons is Mr. Lawrence, and we'd like to excuse him if the panel isn't completed on time.

Secondly, sir, I have brought up with me some 35 responses to requests made of previous panels, and we'd be prepared to file those when this panel is completed or at the start of the evening session, whichever happens first and whichever is most convenient.

THE COMMISSIONER: Thank you, Mr. Gibbs. Mr. Ryder?

MR. RYDER: Yes, thank you, Mr. Commissioner.

MR. MARSHALL: Excuse me, sir, before my friend begins questioning, I have the next panel for Arctic Gas available and they had asked me whether or not it was intended that we sit tonight?

THE COMMISSIONER: Yes, I intend to sit tonight and I think that we will begin with your panel as soon as Mr Ryder's cross-examination of this panel is completed.

MR. MARSHALL: Fine, sir.

THE COMMISSIONER: Will that be all right?

MR. MARSHALL: Yes, they'll be ready.

L.W. BOUCKHOUT
C.W. DREW
FREDERIC B. CLARIDGE
D.M. DAVISON
HERMAN VAARTNOU
NORMAN A. LAWRENCE
JAMES R. TAYLOR
BRIAN O.K. REEVES, resumed:

CROSS-EXAMINATION BY MR. RYDER:

Q Mr. Bouckhout, I wonder if I can begin by putting to you some general propositions for environmental concerns, and these, I might say to you, are the same general propositions that were put to Mr. Hemstock of the Arctic Gas Phase 2 panel, and the purpose of doing so was to see if there is any difference in the approach which you take on a general basis to the general weight of these matters compared to the Arctic Gas approach. Now, the first proposition is that the land or landscape should not be unnecessarily disturbed and I put to you this is a proposition that applies everywhere, not just in areas of high sensitivity.

WITNESS BOUOKHOUT: I would generally agree with that.

Q The next is that visual and aesthetic values should be protected and visual impacts minimized.

A Where possible, I agree.

Q And that third, then, that present wilderness areas should be protected and disturbance of such areas minimized.

A I agree.

Q Fourthly, the disturbance of the ground surface, together with the organic mat and vegetation that protects it should be minimized as a means of reducing or avoiding a wide range of environmental impacts and engineering problems.

A Agreed.

Q And that fifthly, I'm dealing here with the problem caused by the fact that your project will enter into competition with -- for resources which may be in limited supply, and when that competition is engaged, the result then would be that there would be a demand on resources that are in short supply, and I'm asking you if you accept the proposition that they should be used wisely and prudently and that conflict should be avoided between the use of such resources for any one project and other present or future uses of the same resources, and by setting these different competitions which apply to resources in short supply or in limited supply that a set of priorities would be established.

A Yes, agreed, that would have to be worked out, obviously, amongst the people or groups either directly involved or implicated in these, but that's certainly agreeable, yes.

Q All right, and that finally,sixthly, that any overlap of the project lands, on lands which will be useful to man for other purposes purposes of a traditional nature in the future and in the past, should be minimized and conflicts in land use should be avoided, if possible.

A Where possible that's right, yes.

Q And finally the archaeological and historical sites should be projected from disturbance by the project, and that archaeological materials that cannot be protected, some means should be adopted to salvage those.

A Agreed.

Q And then lastly, that where disturbance has taken place and as a guard against future disturbance, that some stabilization and restoration or rehabilitation measures should be implimented.

A Agreed.

Q So that the goals of Foothills, with respect to environmental protection, are in general terms the same as those of Arctic Gas.

A I would think so, if Arctic Gas has agreed to all those suppositions.

Q Now, I want to now turn to the measures you propose to approach and achieve these goals. First of all, I want you just to single out any areas of difference between your approach and

that of Arctic Gas. First of all with respect to the identification of environmental concerns.

A I would think, sir, that as far as the identification of concerns, I can't really speak for Arctic Gas because I am not totally familiar with their identification.

I would think that we would be generally since they're professionals working for both competing applicants. The identification of concerns should be generally similar.

Q All right. If during the course of these proceedings of Phase Two and living environment in Phase Three, a difference in the concerns that you have identified is revealed, you let us know about that so that we can address the differences.

A Certainly.

Q Now, are you familiar at all with the manner that Arctic Gas rates environmental concerns and measures them so that it can proceed with the trading-off processes between one concern with another when that becomes necessary.

A In terms of the way they rate environmental concerns. Is that the question?

Q Yes.

A No, I am not familiar with the way they rate environmental concerns for trade-off purposes.

Q Well, perhaps you and your counsel can reveal if you detect any difference in the process of rating environmental concerns between yourself and Arctic Gas, you can let us know

about that so that we can address that matter as well.

MR. GIBBS: Well sir, we are in some difficulty in knowing what he means by grading environmental concerns where you use a numbering system and number something at one and something at ten or what process he is referring to.

THE COMMISSIONER: I was going to ask the same question.

MR. RYDER: Q Now, I have just assumed through this phase and Phase Three that it will be apparent that the burden of our questions in any event and I believe the burden of some other participants here will be to obtain disclosure of the kind of considerations which the environmentalists of both projects consider in trading-off when the trade-off is necessary but when the environmentalist in another environmental area and if there is any difference in the approach that you detect between your own approach and that of Arctic Gas, we would be obliged to know what that is so that we can adjust particular attention to that.

What we are interested in before Mr. Gibbs interrupts--what we are interested in is distinguishing the differences between your application and that of Arctic Gas.

MR. GIBBS: It is very, very difficult to have to impose upon this witness. He may not even know what has gone into the decision making process of Arctic Gas.

If referred to harming a bird species over harming a fish species. It is putting a burden on this witness that I think he ought not to be asked to bear. He can say this is how we have gone about it. These are the factors that we took into account and this is the decision we received or we made and Arctic Gas can do the same but neither one, I think can build into it. Those things haven't advanced far enough to tell my friend what the difference is and why it happened that way.

THE COMMISSIONER: Well, are you able to enable to enlighten us at all, Mr. Bouckhout?

WITNESS BOUCKHOUT: A Well, Mr. Commissioner, I think I find the question very difficult. That type of questioning since obviously Arctic Gas have resolved their concerns and their approach to environment their way and I certainly haven't party to any of their resolutions as such nor they to ours.

It's very difficult to materialize these types of things to say, you know, you get a rating scale of one to ten and if, in fact, we did do that, then it would be possible for us to compare them but we cannot always use that type of a rating scale. We rely on the judgment of the various consultants, various experts we have in the field to give us an opinion as to what potential repercussions are -- if this or if that and it is very difficult to compare them on a one to one basis.

THE COMMISSIONER: Well, we don't seem to be getting very far with that, Mr. Ryder.

MR. RYDER: No, Mr. Commissioner, let me simply say that the reason I put these questions to the witness and I can appreciate that he may have some difficulty with them, stems from the terms of reference which we have and our obligations to be found to the Foothills application, the tenor of that obligation as I appreciate it is to assess the difference between the Foothills' application and the Arctic Gas application. Which if we can address ourselves to that, if there is nothing left to find. It would seem to me thatthe major burden of Mr. Gibbs is to assist us in doing that. Now, I simply ask Mr. Bouckhout if he is aware of any differences now between the method that Arctic Gas has used and the method. And that's pretty difficult because Arctic Gas hasn't disclosed everything on that score yet.

A That, you know, as you appreciate, it is difficult to answer. This is one of the reasons in my direct testimony where I simply stated how I approached it, or how my department approached it. Beyond that, we pretty much have to leave it up to you,having listened to Arctic Gas's panels and their testimony and our panels and our testimony and whatnot to draw your conclusions from that.

THE COMMISSIONER: Well, at any rate, the principles relating to preservation of

environmental value is that you would find it the same as the principles that have been estab;ished by Arctic Gas but you are not aware of any differences in the application of those principles.
Is that -- ?

A None that at this stage you could really put your finger on per se that you know, I could give to the Commission right now. I think the principles definitely would have to be about the same. You know, we're a bunch of professionals working on both sides of the street and both approaching it, I think, the same way.

THE COMMISSIONER: Working both sides of the street. I thought it was only Mr. Lawrence who worked on both sides of the street.

A There are certainly some differences obviously in the routing or routes there is an obvious difference but beyond that I'd simply have to leave it at that.

Q For the moment then, can I turn to another subject which is the Environmental Education Program which you propose. Now, I take it that this education program must be directed to two levels of employees. And the first level would be those who have a responsibility to introduce and apply the mitigation techniques in the field. Am I correct in that?

A That's one of the levels. That's right.

Q And that the second level would be the work crews themselves who are to be employed on the pipeline?

A That's right. The engineering people involved in designing and so on and the contractors.

Q Now, in your evidence in chief you refer I think to a manual for the education of your engineers?

A I refer to manual of environmental protection measures. This manual would be something which is put together dictating the types of protection measures which will be applied in certain circumstances in certain areas. This was not a-- My direct testimony at least did not refer directly to a manual which be used as an education tool. However, I prefer to call it an information program rather than an education program but something similar ~~will~~ definitely have to

be done.

Q All right. Now, the manual that you referred to, I take it, is a manual for the use of your engineers in the field?

A It would be primarily a manual for the use of our environmental inspectors in the field.

Q Now, do you propose any manual then or any means of educating the engineers in the field who are responsible for applying these mitigation procedures?

A Yes, certainly this will have to be done. We are not yet at the stage where we have firmly developed an information program as such, but definitely this is going to have to be done over some period of time.

Q So, you haven't-- Have you thought about a table of contents or have you thought about the content of a manual of this kind?

A Well, it will probably have to be broken down at least initially, I would think, on an aerial base. That is not a site specific, per se, but an area specific base. For instance, it would deal with spread one, spread two and so on. It would also deal with intro-structure within these spreads and the different concerns applied to the different types of spreads.

Q So, he would know what

techniques to look for in particular areas?

A He would know what techniques are definitely going to be applied and also what techniques over and above those can be used on a discretionary basis.

Q Now, the manual that you have started work on, I take, is for your inspectors?

A Well, as I said, we haven't actually worked on the manual. I said the manual would be prepared and that is definitely true but it would be for the inspectors to use as a guide book for their operation in the field and beyond that there is the information program in which something over and above would be developed for the information or education of both the inspectors and the construction and engineering personnel.

Q And I take it that that manual hasn't been started?

A That's right. I might say that we have had some discussion with various people along this line and we are very concerned and wish to get together with the various government agencies in terms of preparing such a manual and developing such a program.

Q You have then prototypes to work from?

A There is a prototype which was developed for the Mackenzie highway work, I believe.

This is something that could be used as somewhat of a prototype. However, in a construction project of this scale, dealing with the types of concerns we are dealing with and winter construction and so on, it is going to have to be really started from scratch and worked up from there.

Q Has Alyeska got a manual of that kind?

A They have a manual of stipulations, environmental stiplulations, yes.

Q That's just the terms and conditions which apply to the Alyeska line.

A That's right.

Q Do you have a manual which educates and assists the environmental inspectors in Alyeska to perform their job?

A Yes, I believe they do have a manual something like that. I am not personally familiar with it, but I believe they do.

Q Do you propose looking at that?

A Yes, most definitely. We have in fact had the Alyeska people in talking to our environmental people as well as our engineering people in regards to the types of concerns and the types of operations that they have progressed with on the Alyeska line.

Q Well, now if I can turn to

what you propose to do to educate the work crews. Have you devised a course for them?

A We haven't devised a course per se. No, it is a matter of tailoring the types of information to the different levels of people who are going to have to make use of it. I might say this is one of the reasons that the people who are within my own department at Foothills have the broad backgrounds they do. For instance, as I said in my direct testimony, Mr. Byers having had years of experience in pipelining and Mr. Lamb being an accomplished heavy equipment operator and job foreman etc.

Q Well, can I ask you then more specifically, what is your present thinking on the timing of the course, when it will be given to the employees.

A Sorry, I did not catch that.

Q What is your present thinking on the timing of the course; that is when it will be given to the employees?

A It will have to be given to select employees before they actually go into the field wherever possible. This is particularly in reference to the supervisory people. As far as application to the actual construction workers, the cat-skinners and so on, we really haven't arrived at a point where we can say when is the course actually going to be given, if we can in fact call it a course.

Q I am just dealing now with the course to the work crews. I am not dealing with the course or any educational schemes you may have for supervisory personnel. And just dealing with the course that you propose to give to the work crews, have you given any thought to the training of the instructors? Do you want professional educationalists or do you want biologists or who do you want on that job?

A My preference would be to people who have a long suit of experience in the field and can appreciate both the academic or biological or physical environment aspects of the types of concerns and problems which may arise as well as having some sort of appreciation for what the actual construction worker and the supervisory personnel on the job are going to have to put up with.

Q Have you given any thought to when you would give the work crews their environmental education?

A No, that particular aspect of the program hasn't been developed to date. As I say, we are really in preliminary stages of trying to think out what would be applicable and how to approach it.

Q So, I can't obtain from you any concrete thinking now on that topic?

A Nothing more than you have already obtained, no.

Q Again, do you propose to look at what Alyeska is doing in that regard?

A Yes, most certainly.

Q Has any member of your staff done this already?

A As I said we have had some people from Alaska coming, come down to our shop in Calgary and give us a talk in regard to how the Alyeska program has progressed. Now, this one particular individual was a government employee, a state employee, in fact, on Alyeska who is involved in the state surveillance, environmental surveillance of the Alyeska project and we are progressing further with this and we do intend to go to the Alyeska project this spring sometime and spend considerable time there reviewing what is happening and how they are approaching similar types of problems.

Q All right, there may be some evidence later Mr. Bouckhout, sometime as to the contents of the Alyeska course. Are you able now to give us any view as to how you think it is working?

A No, I am afraid I am not.

Q Well now, can I turn to your inspection staff, these are your environmental inspectors. I take it you propose a team of inspectors.

A At present I would think that's probably the best way to run it, yes.

Q And do you foresee a number of these inspectors that you will be hiring?

A A tentative number given my thinking to date I would foresee possibly somewhere in the range of 30 to 50 people, however, I must say that's very tentative and it's going to depend on the final makeup of the actual inspection staff and the inspection program per se.

Q And this is during the construction phase?

A This will be prior to the construction phase. I hope to get it started prior to the actual construction. In other words, in line with our pre-construction and so on we'll follow right through the construction phase.

Q And can you give us any idea as to how you propose to set up this team, where you propose to locate them and where they will be reporting to, and matters of that kind?

A Yes, I can give you a very general scheme now: Again this is based on my thinking to date, and by no means should it be construed as necessarily the final inspection staff or the final inspection scheme; but I would hope to have

people at each spread who would be responsible for both the physical and biological aspects of the program. Beyond that, the people in the individual spreads would be responsible to a district chief, there being possibly up to three districts that would more or less parallel the future operations and maintenance district. So it's in terms again from my thinking to date, the spread people report to a district head, who in turn report to a head of inspection or some such designation in head office.

Q And what type of training are you looking for?

A Again, it's going to be a matter of selection of the individuals who are best suited to this type of a program. As I said earlier, the type of people who we are going to require are people who can appreciate both ends of the stick and just don't have a very long suit in pure academics and can't appreciate construction or vice versa.

As far as the actual qualifications, it's really going to be a matter of qualification of merit, in other words we're not necessarily going to set a minimal educational standard, a Master's degree or a Ph. D. or anything like this. It's really going to have to be a selection on an individual basis.

Q And the man on each spread, what kind of power does he have?

A This is something again which hasn't really been finalized or worked out to

date. As far as powers are concerned, he's going to be responsible to make sure that the measures which have definitely been designated, which are not optional measures but which are actually designated measures are going to be followed, and beyond that he would hae, I would think, the power to adopt discretional measures wherever necessary. This would obviously have to be done in consultation with his own immediate boss, be it the boss on the spread or boss at the district level. I really can't give you exactly again what power he's going to have. We've been thinking along these lines and a couple of fellows in our shop are presently charged with starting to develop this type of program, and toward that end as I said earlier, I'm very interested in the government's thinking, the various government agencies on this type of a thing since I would like to see this type of a program developed in concert with the ultimate government surveillance team, or government inspection team, since we can somewhat parallel our efforts and not duplicate efforts.

Q It would be useful to us, and I believe to the Commission as a whole, if we had some kind of proposal from you in this regard in more concrete terms, and the reason why I'm getting a little difficult with you on this, Mr. Bouckhout, is because in the week of September 15th this matter was raised with the previous panel of your company and I think Mr. Hollingworth said at page 9996 that

this is a serious matter and it has to be dealt with and they will be doing what they can, you would be doing what you could as a company to provide us this information so that we could adequately examine. I was wondering when you thought that you would be in a position to reveal your proposal to us so that we can have a look?

A Well, I really can't at this stage obviously reveal to you any proposal beyond what I've already said. This is our thinking on the matter and this is the way we're progressing and this is the line we're taking towards development of this sort of thing. Again I say that I have been in contact with some people in the Federal and Territorial Governm ent agencies in hopes that we could perhaps get together on this development at an early stage so that we don't go our separate ways for some length of time and then have to come back to base one and have to knock it over. So that when we're actually developing this thing we're getting together on it.

Q May I just before leaving this topic ask you, to direct you, to obtain your views on a more concrete level. If in the field your environmental inspector proposes a remedy to maintain for example flow downstream of a stream --

A Sorry, to maintain what?

Q Flow level downstream of a stream that's being cut by the pipeline, and he proposes a method of doing this that may be somewhat

expensive and is challenged by the project engineer or his supervisor. Now who resolves that? I'm visualizing a situation where the project supervisor may look at a stream and see no fish there and say, "Why bother?"

A If it can't be resolved on-site at that particular level, it will have to go to a level beyond and in that regard I would say that our environmental inspections and our environmental inspection team would report through a hierarchy which is parallel to but not inter-related with the engineering/construction team per se.

Q So --

A So it has to reach an apex of one point if it cannot be resolved at succeeding levels up the ladder.

Q So until this resolution is arrived at, and the stream I take it does not get crossed?

A It would really depend upon the necessity of an immediate decision. It is definitely possible that at one level the environmental inspection team, be it at the district level or head office level, would have the option of shutdown if necessary; but that, as I say, this is possible but we haven't written it in, it's not concrete or anything yet.

Q Well, if I can ask you to look at your application, 5 10 2, and I'll just read it to you, you say on page 72, 5-D, 5-72, do you have that? You can perhaps -- do you have that, Mr. Gibbs? At the bottom of the page in the last paragraph, 5 10 2 paragraph,

"Enforcement of Environmental Policy."

A I have it here.

Q Now, the sentence that I'm referring to,

"The applicant will employ a team of environmental inspectors who, in conjunction with spread superintendents will be responsible for enforcing environmental guidelines and regulations."

Now I take it the relationship between the spread superintendent and the environmental inspector hasn't been worked out?

A No, it hasn't, but it would be a parallel relationship, however. The environmental inspector, in other words, would not report to the spread superintendent.

Q So they would have equal authority?

A They would have equal authority in terms of actually trying to resolve the problem which was not already resolved through application of a specific measure or specific regulation.

Q All right, and doesn't that really give the environmental inspector a veto power, or the right to stop work , simply by his refusal to agree?

A As I said, the environmental inspector at some level would essentially have this power, but we haven't designated at what level he would have the power yet.

Q Now, I take it that you would visualize -- can I ask you this question? In your view, can the environmental inspector, does he gain anything by being an engineer?

A What do you mean, "Does he gain anything by being an engineer?"

Q Just so he can be on practical terms with the project superintendent.

A He could possibly gain by being an engineer if in fact he had the background and the other aspects of the program which were necessary to appreciate the environmental concerns.

Q Before leaving this area, can you give us any indication as to when you think you might have your more concrete position available for us?

A Well --

Q Before Phase 3 is finished?

A -- oh no, I wouldn't think so. No, certainly it won't be before Phase 3. This is a continuing thing which really has to be determined in consultation and in a development stage. This thing is being developed and I wouldn't say it would be finalized until that ugly word final design stage.

Q It would be a little difficult at that time to make it a subject matter of this Inquiry.

A That's true.

Q Well, perhaps we can have an argument on that later. Can I ask some questions of Mr. Drew?

WITNESS DREW: I'll try to answer.

Q Thank you, sir. Do I understand correctly that your basic contribution, sir, to this panel deals with your work on terrain , on your terrain sensitivity rating?

A Yes, that is correct.

Q And that the use of this terrain sensitivity rating is one of the ways in which your application differs from the application of Arctic Gas?

A Yes, very definitely.

Q Now, if I can ask you some questions with respect to the role which your rating

can be used in the task of mitigating environmental harm. First of all, sir, the methodology that lies behind it. I'll just see if I can capsulize it,and you tell me if I've misread it. First of all, I understand that you've sub-divided the route into its various terrain units.

A Yes, I''ve done what is called terrain typing or mapping the surficial geological units and features and phases throughout our corridors.

Q And then you've assigned to each unit a sensitivity rating?

A Yes, a range of sensitivity ratings to the units

Q Correct, from one to four?

A Yes, that is correct.

Q Right, and that the basis of your rating is your prediction of the terrain's, the particularrterrain's tolerance to environmental damage.

A I think it could be put that way.

Q So that rating No. 1 would chara cterize a fairly robust terrain, that is more tolerant to environmental damage.

A Yes, it could characterize a terrain that is tolerant to environmental damage either because it's robust or because it's something

that is, say you have a silty very active flood plain with stream flowing, well that's not robust; and if you go on it you're going to make tracks and things but then the water is going to fill those in and the tracks will soon disappear, so it would still have a low sensitivity rating even though it's not robust because it's quickly restored to its natural state.

Q I understand. Now, am I then correct in assuming that once the -- your maps have been completed and your rating system has been disclosed along the pipeline route, that the use to which these maps are put in determining environmental measures, protective measures, that is a subject matter which you don't deal with. That's something that Mr. Bouckhout or some others deal with.

A Yes, I think Foothills and geotechnical personnel and so forth would deal with this. This is just the foundation from which they work.

Q So your work is not to provide a remedy for environment protection itself but a tool to assist in the selection of a remedy.

A Yes, identification of relative sensitivity of terrains on a broad sense, not on a detailed sense for design.

Q Now I wonder if I could ask you or Mr. Bouckhout, some questions with respect to the precise use that has been made of your maps and

rating system up until the present time. First of all I take it that one of the potential uses is in the ability to select routes and alternate routes, along the Mackenzie corridor.

WITNESS BOUCKHOUT:
A That is used for instance in the selection of the location of access roads, access roads from stockpile sites to compressor station sites, sir, to the line and so on.

Q All right, but to go back beyond that, were these maps available to you at a time when you were selecting your routes?

A Selecting the prime route, you mean, sir?

Q Selecting a route within the corridor, that turned out to be the prime route.

A This material has just been generated actually, I believe, after that. Actually, Mr. Fawcett, who was here on the location panel, spoke to the actual application of terrain sensitivity in determining routes, and I'm not exactly sure how he described it. I'm not really sure at what stage they were available.

WITNESS DREW: As I remember that, my sensitivity ratings were not used primarily in determining the route. That was determined in other methods, as Mr. Bouckhout said, it will be used more for planning access ancillary facilities. Also another point, it would probably be useful for and I anticipate that Foothills would use it for is if, after

construction of the line, you have an emergency situation, and have to go in in summer on the surface for emergency repairs or something, you could pick your routes on units of relatively lesser sensitivity.

Q But I take it that as a tool in route selection, Mr. Drew, it has an application.

A A primary foundation application is certainly not to the design stage because there is much more detailed work done by people that follow and the geotechnical engineers and so forth and also our terrain typing as you know and as we have brought out, is not finalized yet. What you see on the alignment sheets is pre-field check terrain typing and of course, we have got a lot more information now and we are in the process of revising and improving upon, our alignment sheets will come out with a better typing and better estimate of terrain sensitivity before we are done.

Q Well, then I take it that until the present time they either haven't been used or they haven't been put in sufficient stage of completion to be of much use to the work of the project to this stage?

A Work of the project in what way? They weren't used as a primary means of selecting the route.

Q Were they used at all in selecting the route?

WITNESS BOUCKHOUT: Yes, I believe Mr. Fawcett again as he spoke to this, and I am not sure exactly what he said, but I believe he did indicate at that time that they had been used in the selection of acces roads and so on.

MR. RYDER: No, we are talking

about the route, not the access roads.

A No, they haven't been used in selections of the route per se. If you are talking about terrain sensitivity now, the terrain typing and the terrain sensitivity are two things. Terrain sensitivity being an expansion or an addition to terrain typing. I believe terrain typing was certainly used in selection of the immediate route or the initial route.

WITNESS DREW: Oh, I might add on that one that terrain typing was used, terrain sensitivity numbers were on the legends of those sheets with the typing so it could have had some small weight.

Q Now, you mention the use of these, of your maps for the location of access roads to borrow pits and compressor stations. Have they been used for that?

WITNESS BOUCKHOUT: Yes, I believe they have. Again, Mr. Fawcett is the gentleman who is responsible for actually the final routing and the actual drawing of the route on the maps and I believe he indicated at that time that they had been used for that purpose.

Q Well, as the environmental chief, are you able to give us any specific examples as to where Mr. Drew's work has been used as a means of mitigating environmental problems?

A Beyond what we have already

said in terms of its use made by Mr. Fawcett, no I can't.

WITNESS DREW: I think most of the application of that will be in the future.

Q I am sorry?

A I think most of the application of my work to decision making will lie in future, when it is completed.

Q Well, now over to you Mr. Bouckhout. How will it be used in the future?

WITNESS BOUCKHOUT: Well, as Mr. Drew has already indicated, it has an obvious use in terms of determining the most applicable or the best ground access to a location where some repair may be necessary. All of our locations are not final. We have already talked about borrow sites, for instance, and certainly it has future use potential here in terms of selecting the actual alignment of the access roads to borrow sites, to compressor stations and so on.

Q Is it a tool that can only be used in the summertime?

WITNESS DREW: No, terrain sensitivity is most critical in the summertime. It could perhaps be used slightly in the winter terrain typing,more in the winter. For instance, if you have some exposed sand dunes that are so exposed that the wind blows the snow off and they are dry, well they will have some terrain sensitivity even in the winter. And the sand dunes are mapped on our alignment sheets,

usually with the sensitivity rating of two and they are one of the rare cases where the sensitivity is not going to decrease significantly with winter, if they are exposed enough so that they are snow free and dry.

Q I think I read somewhere on your map that it refers to summer sensitivity?

A Yes, it does and then in the notes at the bottom, I believe, it is explained the example I just gave of sand dunes or something or somewhere in one of our texts, it is explained or some notes on the bottom explaining the terrain sensitivity legend and I think that is where it explains that usually that terrain sensitivity in winter is low, except in cases, such as sand dunes and other well-drained deposits that are not frozen and consolidated in the winter.

Even the scarp on the edge of a gravel terrace could have terrain sensitivity in the winter because that gravel bank could cave in if you trepass along the top edge of it.

Q Dealing with the manner in which you are going to use these documents, Mr. Bouckhout, do you propose to use the documents as a means of selecting the routes or rather the access roads between say, a compressor station and the line? Or would you use it after the preferred route where the access road has been selected and then use it to assess the acceptability of the access road?

WITNESS BOUCKHOUT: I think it has to be used at both stages. Obviously in the selection of the access road, it would constitute one of the data basis for selection of that particular access road. Obviously you have to take into account a degree of slope and length of the road and the type of vegetation along the particular access and so on, so it is really used as one of the tools or one of the data basis at the selection stage.

Q So, I take it then that at the beginning, when you are selecting a route for an access road, what you do is draw acceptable routes from a terrain rating basis and you can compare them with respect to other environmental considerations that may be obtained in any particular area?

A I don't know exactly how it done. Again, I am not the individual who draws the lines on the map. Our route locator or whatever terminology you would like to use, is the fellow that actually uses this information to draw the lines on the map where the access roads will be and he takes into account things like terrain sensitivity and things like slope and so on.

Q He will be an engineer?

A I am not an engineer sir.

Q He will be though?

A He is not an engineer. He is a surveyor, sir.

Q Well, now what do you then

do with these documents as an environmental manager?

A For these particular documents, I do have some input into the selection of routes and so on but as I have mentioned the prime user of this particular information is the fellow who actually draws the lines on the map. It certainly has potential future use as we have already indicated in terms of designating routes for contingency repair in the summer and so on.

Q I'm not really sure from your answer whethar this is an environmental tool or a tool for the environmentalists, or whether it's a tool for the surveyer.

A Well, it's an environmental tool but it's not necessary that you be an environmentalists to use an environmental tool.

Q Mr. Lawrence, can I ask you some questions so that you can be off as soon as convenient? With respect to disposal of sewage, and I take it that your evidence in chief describes the proposals of both the applicants.

WITNESS LAWRENCE: That is correct.

Q And with respect to sewage, disposal of sewage and solid wastes.

A That is correct.

Q Those two areas, and do I understand from Mr. Marshall and Mr. Carter -- Mr. Marshall is not here -- that Arctic Gas has agreed to be bound by the answers in this regard by Mr. Lawrence?

A I believe that Mr. Hemstock provided direct evidence himself and gave the answer to many of the questions which were put directly to them. I believe, though, you're correct that both parties would be accepting my evidence in the [illegible] in which it' s given.

THE COMMISSIONER: I think we should proceed as if Mr. Lawrence had given evidence as

a witness on behalf of Arctic Gas.

MR. CARTER: On the understanding that he's a consultant and not a spokesman for Arctic Gas, in the same sense as Mr. Hemstock.

MR. RYDER: Well, we did defer our questioning on this subject matter.

THE COMMISSIONER: As if he had been called by Arctic Gas.

MR. RYDER: Yes.

Q Now, I take it from your evidence in chief, sir, that dealing with the disposal of waste water from construction camps that your target is secondary treatment.

A That is correct.

Q And that you propose two methods essentially for achieving this. The first is the mechanical treatment plant which would have some form of backup, and the second is open lagoons.

A No, no, we propose that a lagoon system would be used as a backup arrangement, but the primary tool in every case would be a mechanical plant, and we suggested that we have two types of these types of plants, and the final designation of those has not been decided.

Q All right, so that that does clarify a problem to me. Your proposition then is that there be one method of achieving your target of secondary treatment, and that would be the mechanical treatment plant.

A That is correct.

Q And you just haven't selected the type of mechanical treatment plant .

A That is correct.

Q And each mechanical treatment plant would have some form of backup. I call it a retaining pond, but I suppose it's the same idea.

A That is correct, yes.

Q Now, and so open lagoons do not form part of your proposal.

A No.

Q All right now, I wonder if Mr. Carter can assist me because if I look at the evidence in chief of his panel, the -- at page 36 the basic treatment is described as open lagoons, and the package plants are relegated to an alternative proposition, and I just don't know when I'm asking Mr. Lawrence these questions whether I have the real position of Arctic Gas in my mind.

MR. CARTER: Well, Mr. Hemstock will be back and can speak to the policy of Arctic Gas, but you can put the questions to Mr. Lawrence as to what his advice to Arctic Gas is as consultan t.

WITNESS LAWRENCE: Our advice to Arctic Gas was a mechanical plant with a retention pond, retaining pond as a backup, with disposal onto land.

MR. RYDER: All right, and

you've outlined a number of the problems with respect to lagoons, I think to Mr. Bayly the other day, and I gather that one of the problems is that there's a tendency in permafrost areas, and ice-rich permafrost areas, for thaw bulbs to form beneath the lagoons, the bed of the lagoons.

A That would be correct.

Q And that that causes settlement in the ground beneath the --

A I think, sir, the proposition would have to be a very site-selective one where if you were into a high ice area you would avoid that type of construction. Now, on the diagrams have been shown as a typical site, they have shown a bermed type of construction and this would not necessarily be used in that type of an area.

Q Well, I take it that your recommendation is that it should never be used in an ice-rich permafrost area.

A Yes, but then you could still have a retention pond similar to the one that Imperial Oil have at Tuktoyaktuk, which is totally excavated.

Q How large a pond is that?

A It's quite small; it's meant for a camp of only 50 or 60 people.

Q All right, I'm dealing with lagoons as a method of waste disposal for large permanent camps of up to 500 to 800 men.

A In ice-rich areas we would avoid a type where you would go into a berm type of construction. It would be far better to use natural features insofar as you can.

Q So then, if I can ask you, Mr. Bouckhout, do I take it that you're prepared to accept Mr. Lawrence's advice on that, that there won't be any large lagoons in ice-rich permafrost areas resulting from your project?

WITNESS BOUCKHOUT: This, of course, would be subject to review by various people, including our geotechnical people, in regards to what the potential repercussions would be of having a lagoon in such a location, and as Mr. Lawrence has indicated, it's really a matter of site investigation and site specifics.

Q Well --

A So I can't say carte blanche right now that in continuous permafrost zone there would absolutely be no lagoons.

Q Is there any doubt that in an ice- rich area that a lagoon for a large camp is unworkable?

A Are you asking me, sir?

Q Well, I think I should ask perhaps Mr. Lawrence.

WITNESS LAWRENCE: It certainly would not be my recommendation that you would take any portion of high ice and try to contain

a warmed water within it. I think that in each case that I have examined, where I have looked at this type of thing, generally speaking you would attempt to use the natural feature, either do away with the retention pond as such and use a very small pot-hole slough that exists. You hit many of these in the tundra area, or even further south; but to avoid construction which has to be worked over later or abandoned with additional work going into the abandonment. Where lagoons can be built in an orthodox fashion, we would use them; where they cannot, we would just have to use natural features.

Q All right, so if Foothills accepts your advice then, I take it, there won't be any large lagoons constructed in ice-rich areas which will require continued maintenance to maintain the berm.

A That is correct.

Q All right, and dealing with -- there is -- dealing with a suggestion that you made that you would use smaller retention ponds from natural features, do they -- would that use not create problems in the restoration of these features after the camp is abandoned?

A It may for a short period of time. I think, though, that the least less work you can do on it, the quicker the restoration will be.

Q You answered some

questions last time, I believe, Mr. Lawrence, with respect to the mechanical treatment plants and I think it was agreed, was it not, they present a highly specialized piece of equipment which require highly trained personnel to operate them?

A Reasonably high, yes, but still within the capabilities of trained technicians.

Q Yes, and that each module, I take it these plants come in modular form.

A Yes, they have a limited capability and therefore you have to limit the number of people that you assign to each one.

Q All right, and that when that particular plant isn't large enough to accommodate the demands placed upon it, then another plant can be installed beside it.

A That is correct.

Q And that each plant or module requires its own back-up unit.

A No, not necessarily. You could have, just for example, an 800-man camp with four of these modules, but served into a single retention unit.

Q And what happens if all four plants go out at the same time?

A That's rather unusual, I would think. But I think I also pointed out that the material we're dealing with is not a dangerous

substance and there are many, many examples where short and long periods of time sewage in its rawest form has been deposited into the environment without any lasting damage.

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Q Well, I take it that the purpose of these back-up units is really two-fold and one is to provide further treatment and that does take place, does it not?

A That's right.

Q And the second is that to provide a back-up in case the module breaks down or the plant breaks down.

A In case the module breaks down or there is a lapse of something in the either the operation or lack of material, lack of supply in the biological units, it takes a little while for them to start their proper action. This type of thing would then provide the aid treatment until that unit comes up with proper operating capability.

Q Now, where the plant is broken down, I take it that the back-up unit would be receiving raw sewage?

A That is most likely, yes.

Q And, when that is done and the module is placed again in working condition, what does one do with the sewage that has been emptied into the module, into the back-up unit?

A It is left there.

Q No process of taking it out and putting it back into the plant?

A No, I don't think this is a requirement unless it's a very extended one but I don't see that as being a thing that I would recommend

at this stage of the game.

Q I suppose it would depend how long the break-down lasts because you would have in the retention pond sewage which is not receiving treatment that will achieve your target.

A These units use very basic methods of treatment for primary treatment and unless the unit itself, unless the tank itself is taken out of service for some reason or other, then the sewages always receive primary treatment which means a removal of floatable or settleable solids.

Q In your evidence in chief at page 39, you refer to another form of back-up but you don't describe what that is.

I think you say that in most cases, your back-up treatment will be retention ponds and apply the use sometimes of other forms of back-up.

WITNESS BOUCKHOUT: A Which part of page 39 is that, sir?

Q Paragraph 4 on page 39.

You say in most cases this would be in the form of retention ponds.

WITNESS LAWRENCE: A I think I was talking in terms of multiple units where the unit from one module which could be used as a back-up for a second module. The other thing that we would certainly have would be the time-honoured thing of having duplication of some essential equipment. For

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instance, two blowers on a biological unit. That type of thing.

Q Can you outline the recommendations you expect to make to your client with respect to the restoration of retention ponds after you are done with them?

A Oh, I think actually if we had a constructed retention pond at the compressor station sites, it was our recommendation that that pond would be left in existence to serve as a complete treatment unit for continuing operation. I think I have pointed out in both reports that using mathematical figures you could show that a short retention period say 10, 15 days for a large camp would be equal to a year's retention for the operation or maintenance people on the compressor units.

So that, for the continuing operation the pond would be left in existence and could well become the sole treatment unit. This would be an addition to say a holding tank which would be in the whatever quarters was left at the compression -- at the compression station site.

We had stated that the mechanical units may be left in on the compressor station sites too but generally speaking unless this was started up again for a fairly extended period of time, the sole treatment unit would be the pond.

Q Well, there will be some retention pond at sites that are to be totally

abandonned that aren't associated with compressor stations. Now, what do you propose when sites of that kind are abandoned?

A Well personally, I have given very little thought to that. I would think it would be almost the same procedure as abandonning part of any gravel pad. If there was a berm, I would think you would certainly either spread it or remove it. I think if it contained good gravel for instance the good gravel would be salvaged and taken away.

Other than that you would flatten, possibly cover with material that would grow grasses and have it restored in that fashion. And that permitted to go back to natural vegetation.

Q What about the sludge that has settled to the bottom of the pond?

A Well, this in itself isn't bad material for growing things on. I don't think I would attempt to remove that at all.

Q And the liquid on top. Would you keep that as well?

A Well generally speaking, the liquid is drained off.

Q Now, We have heard some evidence that a large quantity of water will be consumed on a daily basis by your clients in these construction camps and I want to ask you some questions, if I may, with respect to any problems that you may see associated with discharging large quantities of

water after they have been used? Now, we have had evidence from your client, Arctic Gas, that they propose using 800, sorry, 80 gallons per man per day and in an 800 man camp, that comes to 64,000 gallons. And it could be higher. I think Mr. Williams for the Arctic Gas panel indicated that it might be higher.

Now, how do you plan to dispose of that water after you have -- after it has been used?

A Oh, I thought that was the whole point of the sewage collection, the treatment and disposal system.

Q That's processing the material, isn't it. After you have processed it, what do you do with it?

A Well, then you're talking last of the small retention pond?

Q Well, I take it that the quantities to be disposed of will be similar to the quantities consumed. The water coming in to the camp will become sewage and will have to be discharged.

A That's right.

Q And have you considered and I understand your evidence that you propose to discharge this liquid or this water on to ground onto the ground and into streams and perhaps into the ocean.

Now, is that related to the three areas of discharge?

A Well, we want to avoid

discharging into the bodies of water wherever possible. I don't think this would preclude the ocean. And again I am talking of treated sewage.

Our recommendation was that wherever possible that this be discharged on to swampland or wet land.

It then spreads out and becomes part of the natural environment.

Q Right. Now, Mr. Bouckhout, have you considered the biological effect of discharging large quantities of water into swamp?

Now, I understand that swamps are not necessarily the lowest level of the environment, that they may be unpleasant to people but they are very active and there are other things that live in the area.

A Mr. Lawrence, has already indicated in previous examination that swamps have been used extensively for this particular purpose and as such have operated quite effectively in terms of negating any serious impact of this particular material on the environment for any space or distance. As Mr. Lawrence has indicated, we would very much try to avoid disposal of this material in any water body, per se, such as a lake or a stream.

Q Dealing with swamps, has Foothills considered the biological effects of discharging large quantities of water and so on?

A We have certainly, I believe, through Dr. Lawrence, I think, considered this to some extend in regards to Dr. Lawrence's experience with this particular method and the experience of other investigators who have written on this particular type of method. For instance, the town of Hay River discharges into a swamp land sort of affair and this has been studied fairly extensively by various biological people.

Q And as a result of your studies, what effect can you predict?

A This is not a result of our studies. This is a result of studies that have been done, for instance, relative to the environmental social program.

Q As a result of the studies you have looked at, what consequences can we predict?

A I personally don't know. I haven't evaluated it. The people who would be primarily concerned with this particular aspect of the program would be Mr. Lawrence and our aquatic biologists, for instance, who would have to evaluate the particular location where this material is to be discharged.

Now, this is again a site specific detail which has to be looked into when you are determining the actual ultimate end of the material.

Q Well, site specific or not, it is proposed that you discharge large quantities or water in swamps? I want to know whether you studied the consequences of your proposition?

WITNESS LAWRENCE: I think that has been looked at in other areas. In actual fact, Hay River is one which was quoted but others such as Camp Takhini at Whitehorse and the effects are that there is a greater growth due to the nutrients inherent within the sewage itself.

Q That's the greater vegetation growth?

A Yes, greater vegetational growth and possibly a flurishing of some types greater than others or more than others.

Q Now,--

A But, nothing detrimental.

Q Your discharge will occur during the wintertime?

A That's correct.

Q And can you really say that nothing detrimental will occur to the beaver and the muskrat that lives in the swamp?

A Well, again we would avoid places where the beaver and the muskrat are. We are talking about wet lands, we are not talking of lakes and sloughs.

Q So, your selection of swamp areas will depend on what you find there when you go to the site?

A I would think that the biological people would be most reluctant to allow us to use a swamp or land inhabited by muskrat or beavers for that use. We are capable of piping this for reasonably long distances.

Q So, you could vary the location of the--

A That's correct.

Q All right. The problems that suggest themselves for the moment, and I wonder if you, maybe your not the person to ask. For example, the air holes of some of these animals could have been covered up as the ice freezes and builds up a layer of ice over the swamp land area.

A Well again, in my experience, this type of animal wants free water. It is not looking for swamp land. Beaver and muskrat live in lakes and ponds where there is free water under the ice.

Q I believe it was last

Thursday or Friday, page 13117, you did indicate the areas of discharge would include land and streams or into the sea?

A This was on one particular site, yes.

Q Komakuk Beach?

A Yes.

Q Well, now that is one exception. I am really trying to determine what you can tell me about your plans for discharging into streams. You told me a minute ago that you weren't proposing to do so and now I believe you are suggesting that you are in some exceptions. Are there others?

A No, I think I was trying to describe the problem of coming up with a positive solution without having seen the site and having merely looked at a large scale map and seeing that there is a coastline, there are some streams and some swamps in the area. My evidence was that these three possibilities existed. Again, just to clarify that thing, if we were right on the coast and there was a small stream or something like that that the biologists said was not useful for other types of animals and I am thinking more of a wash-out and I think that's what that thing is. It is not really a stream. I wouldn't hesitate during winter months to deposit treated effluent into that stream. I would presume in that case, we would be in the last 200 feet or 300 feet of the stream before it hit the ocean.

Q All right. Now, can I ask you to address the problem of garbage removal and destruction and I am concerned about the garbage generated by the lunch remains of employees who work along the pipeline route and maybe at construction sites, such as compressor stations during the summertime. There will be some summer construction work going on I take it?

A Right.

Q And I understand that any presence of loose garbage provides an immediate attraction to bears and foxes in the neighbourhood, which can become a nuisance and have to be destroyed? Now have you addressed that problem?

A Yes, only as a matter of principle though. But I think the solution to this is already being adopted and used by the various seismic camps, drilling camps in the areas where they have mobile incinerators taken right along with the crews and used everyday. Garbage is not allowed to lay around and attract both flies and animals.

Q So, I take it Mr. Bouckhout then, that any inclination that one might have of throwing an apple core into the woods or off the site somewhat, would be forebodden?

WITNESS BOUCKHOUT: Well, yes. I think we are going to have some difficulty controlling every apple core, but certainly as a general rule, we will definitely collect this material and incinerate it.

Q Have you investigated the

Alyeska experience on this particular problem?

A Personally no, I haven't.

Q Because I understand that it was a recurring problem there that seemed to occupy a great deal of the staff, the time of the staff for both General Rollins and Mr. Champion.

A I can certainly appreciate that it could be a potential problem. You just have to look at our National Parks to realise how big a problem it can possibly be.

Q In a seismic or drilling camp situation, isn't that quite a different proposition, Mr. Lawrence, than men who are working out along the pipeline route? In the seismic camp or drilling camp, the men are never very far from the base where the dining facilities are? Whereas a pipeline, they are strung out along the whole route for the rest of the whole day?

WITNESS LAWRENCE: Yes, I think keep in mind though that this again is wintertime construction that we are talking about along the pipeline.

Q Well, there will be some construction activity?

A I would have to agree that this is a problem and I think again like most garbage is a problem, the solution to the problem is one of policing. Just the exactly the same as in any community.

Q The problem in the wintertime,

I take it, is with regard to animals that don't hibernate?

A Right.

Q Like the fox.

A I think the pipeline, as I know pipelines, the solution is there and that such materials, the natural place to throw things is back in the ditch, particularly organic things in paper bags and soon it is covered up.

Q Now, can I turn to page 40 of your evidence in chief, with respect to the disposal of non-organic wastes. And you speak at the bottom of page 40 in response to question 8, that a large variety of items will be collected and buried at an approved site by an approved method. Now, can I ask you what you meant by approval in that sentence?

A I think the basis of my reply here goes back to the various governmental directives and literature that they have provided for the pipeline guidelines and in there, in many cases, they speak of having centralized dumping grounds and also methods for disposing the wastes, rather than have them spread out all over the place to make sure that the policing of such, that they are collected in central locations and either buried or covered up or disposed of at one place instead of thousands of places. It is an extension of the program that they have been carrying on themselves over the past few years.

Q I take it the main criteria for concern to be addressed in this area is the methods you have for operating this site while it's open, after you've selected it, while it's open and while it's receiving these materials.

WITNESS LAWRENCE: Yes, I would think that any site selection would be done really by the Environmental Protection Service people in consultation of course with the people that are working there; but again the criteria would be to make sure that they have a collecting point rather than a spreading out of solid wastes all over the landscape.

Q Are animals a problem with respect to the operation of sites of this kind?

A Of the type of wastes that we would be putting there would be non-organic and I don't think the animals would be a problem.

Q Have you considered what you propose doing to restore these sites after you've finished with them?

A Yes. Well, I think that we say "approved methods", and generally speaking I think that for those materials which are not going to be taken back for recycling, which are going to be left on that site, I can only assume the approved method will be covering them up with material, burying them.

Q So that is the method that you propose or advise?

A Yes.

Q Do these sites have to be marked after they've been used?

A Yes, that is also one of the criteria they have, that these sites be marked for future generations.

Q Why is that necessary?

A Well, so that people establishing a new site three or four years down the line can use the same site rather than start opening another one. Secondly, so that people digging into them won't be surprised when they find a derelick engine pump or wire.

Q They won't mistake it for an archaeological site.

A I question whether the sign would last.

Q Well, thank you, Mr. Lawrence. Before I leave this area it might be useful to refer specifically to the page in -- and a portion of the evidence in chief of Arctic Gas Phase 2 panel, that appears to be different from the proposal and the recommendations that you're giving to that client. So that the record can be straight as to the source of my perplexity, and that is at page 36 paragraph (b), if I could just ask Mr. Carter to note that --

MR. CARTER: Paragraph (b)?

Q (b), maybe I can ask you to comment on it, Mr. Lawrence. Perhaps if I can read

it to you, it states:

"For camps occupied on a year-around basis, the basic water waste water treatment component will be open lagoons with a one-year retention capacity. Such units are in successful operation in many northern communities. They are economical and require little maintenance by producing quality effluent. Where lagoons are not practicable, packaged mechanical treatment units capable of providing secondary treatment will be installed."

Now that's the proposal in the Phase 2 panel, Arctic Gas, that does appear, am I not correct in saying, to be the reverse of your proposition?

WITNESS LAWRENCE:

A No, I think it is exactly the same. What I have said there was that for the construction camps occupied on relatively short term, the mechanical plant would be the basic unit. Where we go into compressor station sites, where the operation continues year after year after year, the lagoon which was a relatively small unit, and might be the same short retention pond that was used in the construction period, would be the basic unit.

Q If I could just stop you for a minute, what we're dealing here is the methods for camps occupied on a year-around basis.

A But the only ones that will be occupied on a year-around basis are those on the compressor stations. There's no other camps.

Q What about camps at stockpiles?

A Well, they would disappear at the end of construction.

Q And until then they have a two or three-year continuous use?

A That is correct.

Q And would they fall into that category as you've described here?

A Well, again without knowing the specific instance, my recommendation is that they would follow a mechanical treatment plant use, with a mechanical plant being the prime unit and possibly a backup type of lagoon.

MR. RYDER: If I may have the Commission's indulgence for a moment?

I'd like to ask Dr. Reeves some questions about archaeology.

MR. GIBBS: Perhaps Mr. Lawrence could be excused, sir, if Mr. Ryder is going onto archaeology.

THE COMMISSIONER: Well, you feel free to go and get it whenever you want to go and get it.

MR. RYDER:Q Now, Dr. Reeves, at page 47 you refer to known sites that are adjacent to or nearby the pipeline route, and I believe one of your concerns you've noted is that they may be

impacted by acts of vandalism.

WITNESS REEVES: That is correct.

Q And so your solution is to integrate these sites into your general archaeological program.

A Yes.

Q Right, and what does that mean? What form of protection will be provided by doing that?

A By monitoring the sites, by designating them, putting the sites into the educational or, excuse me, informational or other programs designed to acquaint the personnel with the site, with its value, and to attempt to ensure that they do not vandalize it. Also, they are protected under Statute.

Q So that by your education program the work crews will be familiar with the location of the site.; and then by your surveillance and monitoring program you protect the site.

A Most of these sites are already known. I think I should perhaps, to qualify it a little bit we 're talking primarily about the outstanding sites, such as an example site. These are known today. We can advise them and designate them and inform the personnel to avoid them. So you're quite correct, they will become aware of the existence

of them.

Q Do you propose, when you say "monitoring these sites", does that mean you will have people present to protect them when the pipeline is proceeding nearby?

A They would be checked, I would visualize them being checked during construction periods, for evidence of such activities as vandalism.

Q And how will that protect the sites?

A It would identify if in fact people are vandalizing the site, and perhaps some sort of measures can be taken to stop this.

Q And those measures, I take it, would be an increased form of surveillance?

A Yes, and also discussions to identify the parties responsible. Site protection is a very difficult problem no matter where we are. It's very difficult. Hopefully it will be less difficult here than it is south.

Q Do you visualize, Mr. Bouckhout, staffing and financing a surveillance team for that purpose?

WITNESS BOUCKHOUT: This would very much depend upon the recommendation of Dr. Reeves, the particular site involved and so on. Certainly it is a possibility to be considered. Of course again, dealing with winter construction, the sites won't be particularly evident, nor will they be particularly

accessible, so that shouldn't present a great deal of problem in regards to the winter construction phase.

Q I take it that, Dr. Reeves, where the pipeline crew is in the vicinity of an outstanding site that hasn't yet been excavated, that it would be your judgment to avoid excavation of that site where at all possible.

WITNESS REEVES: A That is correct.

Q And I understand that I am just repeating the contemporary wisdom of your field that excavation is to be avoided unless it is necessary to preserve the site from destruction or unless the excavation forms part of a planned scientific overall scheme and the information from that site is necessary.

A Yes. We had to consider, of course, cost of avoiding the site versus excavating the site.

Q Well, I'm now dealing with the sites that aren't necessarily going to be disrupted by the passage of the pipeline. Now, can I turn to your plans for locating sites along the pipeline route before the ditching machine starts its work? Can you outline those plans for us?

A Yes. The plans would consist of essentially two major steps; the examination of areas prior to line finalization which are particularly archaelogically sensitive. I should say, qualify that in saying potentially. That is, areas which may well

contain archaelogical sites, river crossings, intersections of lakes, etc. This would be done before there was any clearing.

The second major phase of site identification and location would be after the line has been cleared and prior to ditching to identify sites which could not be located prior to that.

Q All right. And I think in response to Mr. Bayly's questions last week, you indicate that there are sites that we're dealing with fall into two broad general categories.

The first category is sites of more recent vintage that can be detected by examining topographical features in the landscape that you can see exist and then that's the first category.

And the second category is sites that are older and more deeply buried that were located by reference to topographical features that no longer exist. Have I correctly -- ?

A That's essentially correct.

Q All right. And during the course of your discussion with Mr. Bayly, you indicated that there will be a -- you mentioned drilling along the route as a means of detecting the older sites.

A I believe Mr. Bayly mentioned that.

Q All right.

A As a possible method.

Q Yes. And that drilling that, I gather you understood him to be referring to is drilling that takes part in the course of the pipeline construction. It's not designed specifically to locate archaelogical--future archaelogical dates.

A Can you give me the page number on that?

Q Page 13,080 just before Mr. Bayly started talking about Little Jack Horner putting his thumb into the pie. He deals with --

A I have the page.

Q At the top of the page with the drilling program. Now, the drilling program that I take it is referred to there is the construction pipeline running from there which may as an added bonus reveal some artifact?

A I believe I would interpret Mr. Bayly's question to refer to that but we would also in certain areas of particular interest to us do drilling or augering, searching for subsurface remains deeply buried.

Q Now, does that form part of your firm program for Foothills?

A Yes.

Q And is that to be done after a study of some kind of topographical map that will indicate the previous landscape that is not visible to -- ?

A No, that would have to be done after both study of aerial photos, past environmental data, and field investigations.

Q So that is a firm undertaking that will be done by -- ?

A That's if such areas do, in fact, exist, that require that type of work.

And, I believe it's in the impact in the statement of Foothills that subsurface prospecting will be used.Q:And, dealing with evaluation of sites that have been discovered, prior to ditching operations, I take it that the discovery will take place during the summer following the clearing of the pipeline route?

A Yes.

Q And, at that stage, do I understand correctly to say that the pipeline company really has three options when a site is located. The first option is to consider moving the line if the site is sufficiently important -- if you can persuade them that the site is sufficiently important.

The second option is to salvage the excavation, to do a salvage excavation before the drilling machine or the site is destroyed rather by the ditching machine.

And the third option is to simply flag a site and return to it after the pipeline has been laid. Are those generally the three options that the company has available to it?

A In general yes. However, the third one, I would qualify it as it would be flagged if there wasn't sufficient time to investigate it, if the time lead got too short. Otherwise, perhaps it would be flagged if it was just peripheral to the line or it may be just as well be ignored if it is of no value at all.

Q Right. Now, the main problem then in selecting the first two options is the limitation of time between the clearing of the land and the ditching of the land. And you haven't got much time if you discover a valuable site or a site that you evaluate highly to persuade the company to change the route?

A The time is limited.

Q I beg your pardon.

A The time is limited.

Q Yes. Now, dealing with the problems of time, do you expect to be provided with a reasonable time period to first of all locate a valuable site if one is there and then evaluate it and then thirdly say persuade the company to move its route or do a salvage excavation?

WITNESS BOUCKHOUT: A In regards to time, to put the time element in perspective along about half of the route there would be a minimum of one year and along the other half there would be at least two years so we do have, you know, a considerable amount of time for reconnaissance and site identification

and so on.

Q In a minimum of one year or a maximum of one year?

A I would say a minimum of one year.

Q And that's over half of the route?

A That's over the part of the route planned for the first winter of construction.

Q And so for the balance of the route, you feel that Dr. Reeves will have -- ?

A Well, over the portion of the route planned for the second winter of construction over a good part of that route you would have the two years.

Q Well now, how do you calculate that year period?

A Well clearing will proceed in one winter. The clearing will be done a good portion at least on the line and so on will be done in one winter. The construction of the line would proceed the following winter and the construction of the latter part of the line to be constructed would proceed the winter thereafter.

Q All right. Now, Dr. Reeves, I want to place you in a position where you have discovered a site and then I take it that the job is evaluating the site?

WITNESS REEVES: A That is

correct.

Q And that I understand will be done by an archaelogist?

A Yes.

Q Proposition. And can I refer you to a report which sets out the criteria or suggested criteria for evaluating sites of this kind? Are you familiar with the preliminary archaelogy study -- archaelogical study -- of the Mackenzie Corridor?

A The first or second report?

Q The second report by Dr. Cinq-mars. And could I ask you to refer to page 28?

A Yes.

Q Well, you see at the bottom of the page, has this been made an exhibit? Perhaps we can after we have used it in this examination Mr. Commissioner, submit it as an exhibit. It might be easier for you.

At the bottom of the page, in paragraph 824, the author sets out certain attributes which he suggests be used to determine the individual site salvage needs. And the first is great lateral extent. I take it he is referring to the size of the site, is he not?

(PRELIMINARY ARCHAELOGICAL STUDY, MACKENZIE CORRIDOR/ SECOND REPORT, MARKED EXHIBIT 313)

WITNESS REEVES: Yes.

Q And the second is complex horizontal and/or vertical strateography, stategraphy, and I take it that indicates the same implications. The size of the site does it not?

A That has a similar connotation and in fact it's what he refers to is probably, if I interpret it, a number of occupations, different times and uses.

Q I see, and the third is the presence of large and complex ground features.

A These are remains of structures.

Q And the fourth is indications of very great antiquity of the remains. That's self-explanatory, I take it.

A Yes.

Q And the fifth is good organic preservation. Now, the conclusion that the author comes to is that for any given site, if one finds more than one, which I take means two or more of these characteristics, that it's his view that every effort should be made to salvage the remnants.

A Or protect them.

Q I think he says total protection.

A If they have two, yes.

Q But if they have one?

A If there's one, then every

effort should be made to salvage it.

Q Yes. Now dealing with that method and that scale of rating an archaeological site, can you give your comments to us?

A Yes, I think I should point out that in general this is concurred with. However, in a summary statement such as this, that is more complex; in general yes, I agree with it, but it is a complicated problem. In some cases it may be a site which is characterized by two of these, which really perhaps does not deserve protection

Q Well --

A There are some other considerations also which --

Q -- I take it it's that kind of thought process which will go into the making of your recommendations.

A Yes.

Q And that Dr. Cinq-mars criteria are the only ones that we have available. Do you have any others that you would propose using that can guides us as to what your thinking will be when the time comes?

A Nothing specific comes to mind right at the moment. I'm afraid I have a very bad head cold and my thought process isn't working.

Q It would really be a problem of applying these general --

A Yes. For example

let me take one criteria, four indications of very great antiquity of the remains. Now we may find a site which is perhaps 100 years -- well, 200 years old, which on land is a very important site and should be avoided. So therefore greatest antiquity in itself is not sufficient, or necessary in combination with something else.

Q Well now, after you've applied criteria of this kind and made an evaluation of the site, you would then make a recommendation to the company.

A Yes.

Q And from your discussions with the company, do you have any idea as to whom or to what level you would make that recommendation?

A There's been no discussion as to the formal procedure in which it would go. I might point out this would also have to be referred to external review by interest groups and the agencies responsible for archaeological resources materials too.

Q So they would be notified immediately then?

A They would be notified and I presume they would have to evaluate the decision made by the company.

Q What external groups are you thinking of?

A I am thinking of sites in which native peoples might have some particular

interest or concern.

Q Yes, and then you would notify outsiders quite apart altogether from your client,you would notify governmental people and other interest groups that may have an interest in archaeology.

A Archaeological sites.

Q I'm asking you what other organizations do you have in mind?

A I presume the government would designate some referral group specifically to monitor the archaeological program which the pipeline company would be carrying out. Archaeological work has to be carried out under separate permit.

THE COMMISSIONER: Mr. Ryder, how are we getting along here?

MR. RYDER: Well, there's some very interesting things about archaeology to come, Mr. Chairman, I'm afraid.

THE COMMISSIONER: Well, we'll adjourn for a few minutes for coffee now. Before we do, I think I should say that I have been advised by Mr. Scott that I've been working everybody too hard at this Inquiry. I don't think he was thinking of the lawyers, he was thinking of the official court reporters and the typists, and I know we've been working very hard but we may have to continue to do so in order to finish Phase 3 by Christmas, and I certainly appreciate the work that the court reporters have done. Sometimes we have been sitting from 9 in the morning

until 9:30 in the evening, so I am going to hold a reception at the Inquiry's Offices this Wednesday evening at 8 P.M. and I hope that all of you will come, the court reporters, the typists, counsel, witnesses, staff members of the Inquiry, and each participant, and the C.B.C. and the press, and I hope you will bring your wives and husbands, that is if they are nearby.

So we'll adjourn for coffee.

(PROCEEDINGS ADJOURNED FOR FEW MINUTES)

(PROCEEDINGS RESUMED PURSUANT TO ADJOURNMENT)

THE COMMISSIONER: We'll call the hearing to order again. Before you begin, Mr. Ryder, I want to make an announcement.

The Chamber of Commerce of the Northwest Territories asked the Inquiry to take a look at the idea of stretching out the pipeline project from three years to four years, both Arctic Gas and Foothills say that essentially the project, whichever one of them carries it out, is a 3-year project, a 3-year construction project. The Chamber of Commerce has asked the Inquiry to take a look at the idea of stretching out the project from three years to four years. Now there has been evidence given that the Arctic Gas project cannot be completed in three years. Foothills says it would take four years or even five years for Arctic Gas to complete its project. Foothills says it can construct its project in three years, and as we will remember from Thursday night, Mr. Scott took some issue with that.

In any event, what the Chamber of Commerce is saying is that the Inquiry should take a look at laying it down as a condition to apply to whichever pipeline company is allowed to build the pipeline, that is that a condition should be imposed that says, "Take four years to build it, not three."

That is even if it turns out that they can build it in three. The Chamber of Commerce says, "Make them take four years to build it." The Chamber of Commerce says there would be some advantages to this. They are anxious naturally that northern business and northern business men should participate in the pipeline project, and for that purpose the Inquiry last year made a grant to the Chamber of Commerce to enable them to carry out an inventory of the existing capacity and potential capacity of northern business to carry out work on the pipeline project and associated development, and to supply goods and services to contractors and sub-contractors.

The Chamber of Commerce says that if the project were to take four years instead of three, northern business men would be able to participate in the project for an additional year. It would also mean, they say, that the project would be on a lesser scale and the extent of capital investment that northern business men would have to make to participate would be diminished. They also say that you wouldn't need 6,000 construction workers at

the peak winter season. They're referring, of course, to the Arctic Gas project. They say that you would be able to reduce the number of construction workers by 20% in each winter, and that you would thereby have a greater proportion of northerners employed on the pipeline as a percentage of the total work force. You would also give northerners a greater opportunity of acquiring the skills to do the jobs that require skills on the pipeline.

Now, this project, we are told, will be the greatest construction project in Canada's history if it does go ahead. So the Chamber of Commerce will have to be prepared to hear the pipeline companies say that the costs are so enormous that the interest charges on the borrowings for even one additional year would outweigh any of the advantages to northern business and northerners generally if the project were to be extended one additional year.

They will also no doubt say that the delivery of gas to the south would be delayed an additional year, if the proposal of the Chamber of Commerce were to be accepted.

Well, these are questions that are important and I have advised the Chamber of Commerce that the Inquiry is going to look into the idea they have raised of stretching the project out from three years to four years, and Mr. Weick, who is the chief economist for the Inquiry staff, is heading up that examination, the feasibility of stretching out the

project from three years to four years, and the examination will be carried out with the fullest consultation with the Northwest Territories Chamber of Commerce and when the study is completed, and it should be soon, the report will be brought before the Inquiry and the pipeline companies will have a chance to tackle the authors of the report.

Let me make it clear that in examining all of these proposals I am simply carrying out the task that has been laid upon the Inquiry by the Federal Government. This Inquiry is bound to consider the impact of a gas pipeline on the north in all its ramifications and to recommend the terms and conditions to be imposed if a pipeline is to be built. That doesn't mean that a pipeline is going to be built; the Government of Canada has made it plain that no decision has been made with regard to the question of whether a pipeline is going to be built. The Government of Canada has made it plain that they do not want to make a decision until they have received the report of this Inquiry. It will, of course, be for the National Energy Board to consider the question whether Canada's need for gas requires the building of a gas pipeline to bring frontier gas to markets in the south, and it will be for the Government of Canada, when they have my report before them and the National Energy Board's report to weigh Canada's need for frontier gas and the impact of the construction of a pipeline on the north and on northern peoples, and then it will be

for them, the Government of Canada, to decide if a pipeline should be built and if it is to be built, then where it should be built and who should build it.

These are political decisions to be taken by those who have been elected to make such decisions, and in the meantime we here at the Inquiry will simply carry on with our work in determining what the impact is likely to be and in devising terms and conditions to be imposed, if the pipeline goes ahead.

All right, Mr. Ryder.

MR.CARTER: Sir, could I ask a question before you proceed?

THE COMMISSIONER: Yes.

MR.CARTER: As I recall the matter of extending the construction timetable from three to four years came up at Fort Simpson, and was suggested by the Chamber of Commerce there. Do I take it that there has now been a recommendation from the N.W.T. Chamber as a whole that this be adopted?

THE COMMISSIONER: That's my advice, and the Chamber in fact was anxious to carry out this study itself and I decided that the Inquiry ought to carry out the study but giving the Chamber the fullest opportunity to work along with the Inquiry in that regard.

All right.

MR. RYDER: Thank you, sir.

Q Dr. Reeves, dealing with

your work that you propose doing between the time of clearing and the time of the coming of the ditching machine, I take it that there are really four steps that you have to go through, that have to be gone through. The first is to evaluate, the second is to advise interested governments and outside groups, and the third is to wait for the input from those interested governments and outside groups so that the company can have the benefit of their advice in selecting what is to be done with this particular site, and then you have to carry out the company's decision. We'll assume for the moment that the decision is to conduct a salvage excavation. Now, how much time is needed for all that?

WITNESS REEVES: This presumably would relate to all sites for excavation, or just those of particular concern?

Q Well, these would be the sites which you thought important enough to advise the government about your finding.

A Well, all I could speak to is the time required for the archaeologists to do their work. This would be dictated to some extent by the nature of the sites themselves. The site evaluation may require and certainly would require perhaps as little as one day's work, perhaps two weeks' work. The execution of a decision, presuming it was to go ahead with an excavation, would depend on the site.

Q Well can you give us an idea?

A Requirements would vary with each specific case. It would be impossible to make a general statement necessarily meaningful.

Q Well, aré we dealing in days or are we dealing in months?

A It could vary from perhaps two or three weeks work to perhaps months depending on man-power available and site requirements.

Q And before that work can be done, the company will want to hear representations from government and representations from interested native groups?

A For those sites presumably which there would be some question over.

Q And the native groups and the governments, they will have to make their own evaluations so that they can provide the kind of input that will be useful?

A I think they would accept the evaluation of a professional archaeologist being employed by the company.

Q Well, now the time available for all this to take place, I suppose it starts after the ground has thawed, so that you can look at and detect these sites and it will end with the first snow, will it not?

A No.

Q When will it start and when will it end?

A Well into freeze-up.

Q For a salvage excavation? Can you do that after freeze-up?

A Yes.

Q You can. So, what kind of time period will be allowed you? It is not the year because you can't work in the-- You don't begin in the depths of winter so you don't have a full year to do this. What kind of time period do you have available?

MR. GIBBS: Commissioner, I hesitate to interrupt but we do seem to be getting into a pretty wildly hypothetical situation. An archaeological site could be big enough for an arrowhead or the size of the Pyramids and who can tell how long it is going to take to excavate, to salvage or what? It is an interesting debate but for something that is not yet found, it doesn't seem to be leading very far.

MR. RYDER: Well, first of all Mr. Commissioner, I am trying to gauge the seriousness of the applicant's proposals in this regard and its major proposals which may be impractical and may be impossible of carrying out. Now, if it is serious, then presumably it would have addressed these problems. I am not asking, for example, in my last question that Mr. Gibbs objected to, I am not asking for the time necessary to do a salvage excavation of this specific

site. I am asking what time does he have available to do that and see if he has considered that problem. Now, I put it to the Commission and I put it to this witness that if the applicant was serious in this evidence, they would have considered these things and they would have had ready evidence available for it.

MR. GIBBS: Well, sir I do take exception to this. This witness has said that he can't tell whether they are buried or whether they are archaeological sites undiscovered until the right-of-way is cleared. And in some cases he can't tell until the backhoe has bitten into it and it certainly is, I think and I submit evidence of seriousness intent, to have professional archaeologists on staff to take care of these things.

But you can't possibly devise careful solutions to circumstances that haven't yet occured and may never occur. It has nothing to do with the seriousness of the proposal. It is the impossibility of planning that far in advance.

MR. RYDER: Well, can I ask you this Dr. Reeves, have you considered these problems that I am putting to you before?

A I have had to deal with some of these problems in my work.

Q Have you considered them in relation--?

A In general planning, yes.

Q Well, in relation to the

role which you are undertaking in this project?

A Yes.

Q Then, I take it that there may, you consider it a problem that may arise after you have discovered an important site and you evaluated it as an important site, that time will be too limited to permit you to deal with it in the way you propose dealing And that is a possibility, is it not?

A As pointed out in the statement.

Q Yes, when that occurs, if you haven't enough time, the solution may be a disruption of construction scheduling? That's one of the consequences of some of the solutions you may be recommending?

A No. The site would be flagged as I said earlier this afternoon, excavated after construction.

Q Even if it is a very important site?

A In my professional opinion, I think most important sites which can be found, either before line clearing, during line clearing, will be taken care of. Those sites, which I think you are considering, are the ones which will be found by ditching.

Q No, no. I haven't come to ditching yet. I am dealing with important sites which are discovered in the summer available to you between

the clearing process and the ditching process.

A I think there will be sufficient time for the majority of those sites.

Q And now I want to deal with those sites that you haven't got time for. Now, from your discussions with the company, can you tell us, and maybe Mr. Bouckhout can tell us, whether he is prepared to consider rescheduling of his construction work?

WITNESS BOUCKHOUT: Well, Mr. Ryder it still remains a hypothetical situation. Rescheduling may not be necessary as we have already discussed. One of the protectional methods of getting around such a problem, if it were in fact a very important site, would be a minor rerouting around the site. It would be a matter of avoiding the site by perhaps five yards, ten yards or it could be a hundred yards. It depends on the aerial extent of the site, its importance etc.

Q I really just want you to advise us so we can gauge the degree of your commitment in this regard, whether you are prepared to contemplate an adjustment to your scheduling.

A We would certainly be prepared to contemplate it.

Q And are you prepared, or have you considered provisions in your contracts with your sub-contractors to enable you to adjust for the time loss and the cost incurred by these kinds of delays?

A Specific to this particular

topic, no we haven't.

Q When you flag an important site Dr. Reeves, what do you propose to protect it, it is on the right-of-way, what do you propose to do to protect it after the ditching passes by, so that any equipment and any use of the right-of-way until you can come back to it, won't disrupt the site?

WITNESS REEVES: Specifics haven't been worked out but in general flagging indicates designation on ground, instruction to company personel etc. to avoid the area.

Q Have you considered laying out a mat of timber to protect the site that way?

A In certain instances that might be desirable.

Q It is matters of that kind that you will be--?

A Yes.

Q Now, in your evidence in chief on page 47, you refer to environmental inspectors. It is in question 17 that I am referring to, that excavations will be undertaken after construction of any sites of value found during the construction phase--No, sorry. Before that you refer to monitored by environmental inspectors.

Now, do these monitors, and I take it that these monitors will have access to an archaeologist, a professional archaeologist?

A That's correct.

Q And the professional archaeologist, he comes to evaluate, not to monitor?

A In certain instances, he would be monitoring certain particularly sensitive areas.

Q So that when you are anticipating your, where you have anticipated the location of a sensitive area, you will have your professional archaeologist at hand?

A Yes.

Q He will be there in the trouble spots?

A Yes.

Q But other than that he will be at the beckoned call of your environmental monitor or your inspectors?

A Yes.

Q Now, how will this monitoring be done. In practical terms, you have the ditching, machine which I take it proceeds at a pace of about one mile an hour or walking speed, maybe a little faster than that, and then you have your pipe laying crew behind it. Now where in that process does the environmental monitor work? Or your archaeological monitor work when he is an environmental inspector who is doing archaeological monitoring?

Now, where in this process between the ditching machine in one end and the pipe laying crew at the other, where will he be working?

A He may be working between the ditching and the pipelaying. He may be working after the pipelaying and before backfilling.

THE COMMISSIONER: How could we really determine that now. What advantage would there be? Surely even if you laid down some kind of guideline that he had to be at a certain location on the right-of-way, he would do what his common sense dictated as he went along, wouldn't he? Is this getting us anywhere, Mr. Ryder?

MR. RYDER: Well, perhaps not, Mr. Chairman, I don't want to press it unduly but it strikes me, as we are again trying to assess the degree of commitment to this portion of the applicant's evidence. Now, if, as I'm lead to believe, the proposal is impractical and it requires to be effective, somebody in the ditch with a flashlight and as the ditching machine is proceeding then we should know that and if that's what they're talking about, we should know that.

THE COMMISSIONER: All right. Then there is two things to find out then. Whether Foothills is willing to commit itself to someone in the ditch with a flashlight -- Well, before we reach that question, I suppose there is the larger question is that something that is feasible?

MR. RYDER: Well, what is needed, I would have thought, to do an adequate job of monitoring for archaeological sites.

THE COMMISSIONER: Well, all

right. Do you have any comments on that, Dr. Reeves? Is it needed and if it is, is it practical? Can you get an archaeologist to spend the best part of three winters -- Well, you would need several of them in each spread. Each would have to spend a winter in that ditch with a flashlight. Is that -- Well no, but you people spend your time digging things up and underground and so forth so we're lead to believe. So maybe that isn't asking too much. What do you say to all this?

WITNESS REEVES: A I think in some areas it's needed. I think it can be done.

MR. RYDER: Q You say, you think it can be done?

A Yes.

Q And can you tell us what you mean by monitoring by these environmental inspectors? I mean would it take up --

A I thought you were talking about the archaeologists before?

Q Well, I am. I am referring to the answer you've given to question 17 and you say the construction activity will be monitored by environmental inspectors who will have access to professional archaeologists. Now, I want to know what role you intend to impose on these environmental inspectors.

A Firstly, the environmental

inspectors will have some knowledge of archaeology and I think we have to establish that. As I pointed out, in certain areas, there will be archaeologists monitoring the ditch. What role they will have yet has to be worked out. To the best of my knowledge, this has never been done.

Q All right. So you have no -- when you use the term "monitor" you really have no content to pour into that term?

A Well, I don't think it would be very relevant to go into specifics of how one monitors the side walls of a ditch for remains of archaeological value.

WITNESS BOUCKHOUT: A Mr. Ryder, perhaps we could put the speed of this ditching process into perspective a bit. Certainly you may be right. I'm not really sure what the speed of a ditcher is. It may be a mile an hour but certainly the ditcher won't be moving continuously for a mile an hour or if it did so, in a couple of days, we'd have the entire winter's ditch open.

I don't think this is much of a possibility.

Q You are making fun of me. I don't propose that at all.

A No, I'm not, sir.

Q I'm simply saying that your evidence has used the term "monitored" by an environmental inspector. We know that these

environmental inspectors have many important things to do on this spread and I also have reason to believe that effective archaeological monitoring requires full time attention and I want to know how you, Dr. Reeves, can square the two competing obligations that you are imposing on these environmental inspectors?

MR. GIBBS: Surely, Mr. Commissioner, it is a practical matter. You have an environmentalist there. He is told to watch out for things being turned up by the ditcher. He has got access to an archaeologist. It is not a cut and dried matter which you can work out on paper sitting in an office. It's on the ground and you do the best you can with what's at hand.

MR. RYDER: Q And the question is, Dr. Reeves, is that practical? Is it worthwhile bothering with it at least? Can you do a good job when you spread the work so thinly?

WITNESS REEVES: A I think it's worthwhile.

Q We all agree on that. The question is can you do the job when you share the archaeological work with the biological work? Or does something valuable get lost between the stools?

A I don't have an answer for that. As I point out, it has never been done in North America, to my knowledge. It is something, I believe, the applicant wishes to do because he feels it is of value.

Q So apart, I take it, from your archaeological, the professional archaeologist, you don't propose any additional staff for that period?

A Well, you used the singular. I didn't.

Q No, I don't mean to say that you were just going to have one but apart from your professional archaeologist, you don't propose any additional staff?

A At which point? For the monitoring?

Q Well, tell me what your staffing considerations are.

A Staffing considerations must be dictated by the requirements of the archaeological program. The requirements for staff, they have to be dictated by determining the requirements for each site.

Q And have you considered how many men you propose hiring and looking for?

A Oh yes.

Q And what conclusions have you come to?

A In the initial phases of value or reconnaissance and evaluation, of areas before clearing of line, during clearing, I foresee no problems in obtaining the required professional archaeologists to carry out these types of operations which I consider to be the most critical.

Q And how many are you referring to?

A We have now made no man power estimates at this time.

Q Then, how can you make that previous statement?

A I feel that sufficient professional archaeologists available in Canada with experience in these areas that they can carry it out.

Q No matter how many you need?

A Well, obviously there's limits.

Q Perhaps, I can go on to Mr. Taylor, then to complete his data. Can you for us, Dr. Taylor, outline the terms of reference that your client has given you?

WITNESS TAYLOR: A The work is in two phases. Phase One is completed and is part of the submission that was made earlier this year. It included a reconnaissance of the corridor which involved evaluating a route alignment that had been selected. The next phase will involve more site specific concerns related to details of borrow pits and other associated facilities.

Q Now, that's your overall terms of reference and that describes your role and your obligations to your client, I take it.

A Well, very briefly.

Bouckhout, Drew, Claridge, Davison, Vaartnou, Lawrence, Taylor, Reeves
Cross-Exam by Ryder

Q Right. Now, can you -- at page 45, in answer to question 9, you indicate that recommendations are being made on an ongoing basis.

A Yes, sir.

Q Right. And can you outline briefly again if you will, the input that you made to your client to date in this project?

A The first step was to inventory, as I said before, the corridor as to known visual features of territorial significance. This was through reviewing various studies that had been done in the past two or three years.

I also did a review of the basic physiographic characteristics or the units that the pipeline would pass through to gain some understanding of what the characteristic landscapes were, to gain a better understanding of the potential impact.

Q Well, can I ask you to describe the role you have played in assisting the applicant with respect to some of the specific problems that he must confront such as the location of the route. Have you done any work on that problem?

A Yes. In that case, it was a matter of reacting to the original proposal. Recommendations were made as part of the team which included biological and geological and other inputs. This information then was relayed to Foothills. Occasional joint sessions were held and in many cases,

changes were made utilizing aesthetic inputs as one component.

Q Can you, so we can just understand what you're talking about precisely, could you make any specific recommendations as a result of your assessment of the route?

WITNESS TAYLOR: I was concerned with location of one or two of the compressor stations initially. I think adjustments were made for that reason and other reasons.

Q Can you tell us where the adjustments were made? Do you know that?

A One case, I can't recall the exact milepost, but the location was relatively close to an area of population. The concern there was from an aesthetic point of view, was potentially visual impact but perhaps annoyance of noise came into play,

Q And so an adjustment was made in response to your particular --

A Well, there are other concerns if I recall at that particular site, including potential biological impact. So I don't recall any case where a major change was made just strictly on visual.

Q I take it that you played no role whatever in the original decision to select a route?

A Well, as I say, a preliminary corridor was submitted to our group. I reacted to it from a -- from the point of view of

aesthetics, and then some changes were subsequently made and I think reflected in the earlier submission. Other changes, for instance, in the laterals, are being reviewed now as a result of both aesthetic and land use considerations.

Q Can you give a specific example of that?

A Well, one example that was brought up last month or so, relates to Pine Point. The preliminary routing carried it through a city park, a golf course, and this wasn't evident apparently on the high level photography. An aerial reconnaissance brought it out and that proposal or that change was suggested and it's being incorporated.

Q Now, leaving that section of the applicant's proposal, your client has told us that you have been engaged for the last few months in any event, in entering on its preliminary design stage, and refining its river crossing locations and matters of that kind. Now have you played any role in this phase of the -- of your client's project?

A In preliminary design phase?

Q Yes.

A Not as yet I haven't begun. By that you mean selection of borrow pit sites, finalization of other facilities and alignments?

Q Yes.

A Yes. No, that work will

begin as the information comes to us.

Q So I take it your role in that phase will be similar to your role in the route selection phase. You will be responding to decisions made by other officers in the applicant.

A Generally, although in the initial study we identified zones of high sensitivity. That information has been available to the group for nine, close to nine months, and it's been taken into account as far as locating facilities in highly sensitive or important areas, in terms of visual quality.

Q So they did have, your client did have a list of do's and don't's with respect to some of the area decisions that have already been made.

A Yes.

Q All right, and would that include route selection? And do I get from that that your role in route selection may have been larger than at first indicated?

A Well, as I indicated earlier, a route was developed strictly on engineering criteria initially. Now this was the preliminary route and this was prior to any submission. So we reacted to that route and identified where potential problems would be. This is in contrast to say if we selected a route based solely on visual criteria, which didn't seem to be practical.

Q Now, I take it that you've described really the work you're doing now and the work you've done in the past.

A Well, I outlined very briefly what we will be doing on preliminary design. We are working on a program now for coming months to look at special problems, and I think borrow pits would be one of the more significant ones.

Q What are you telling us about borrow pits? What sort of things are you going to be considering?

A Again, when we're looking at potential borrow pits, we'll be concerned with their relationship to, first of all sensitive sites, and secondly areas that are close or very accessible to populations of people. We will be looking at some criterion then based on visual accessibility, if you wish. WE'll also be looking at possible techniques or appropriate forms for final shaping of the borrow pits.

Q And borrow reformation, I take it.

A That's right, but more from the aesthetic point of view, we're working with Dr. Vaartnou and I'd say some of the aesthetic considerations related to revegetation.

Q All right, thank you. Now, I take it -- and you tell me if I'm wrong -- that as I understand the subject matter of aesthetics, it's

really a question of taste, is it not?

A No.

Q The values that you have to make in recommending an adjustment because of aesthetic considerations, when you do that you're really relying upon your own particular taste to gauge those --

A Oh, we discussed this at some length, I think, last week. What we're trying to do is avoid that sort of subjectivity. This is why we're, first of all have inventoried known sites that have very high visual quality and have been ranked on that basis by the Federal and Territorial authorities. We have been concerned, as a principle, on facilities or features of the alignment that will be more visible than others, so our work is not that much different than say certain aspects of the biological resource study, where we have tried to identify known and identify further zones of high scenic value.

Q Let me come at it another way. I understood from my reading of your answers to Mr. Veale that you acknowledge that public input by people, the native groups, had its validity, as you put it, in assessing some of your recommendations or making or reaching or coming to your recommendations.

A Yes, I think it does.

Q Yes, and you then refer to some examples in the more southern provinces where programs are developed to permit input by the

local communities.

A That's right.

Q And isn't, in the local communities, I take it you really are imposing, you're looking therefore for some kind of indication as to the subjective views of the community.

A Are you speaking now more of native peoples or --

Q Well --

A -- or a cross section of the population in a given settlement such as Yellowknife?

Q -- I say whenever you look to the local communities to determine what their views are, whether it be in the south or whether it be with native communities in the north, you're looking for a subject ive impression, their subjective impression. Is that not so?

A Yes, I'd say in, let's say in relationship to communities, the opinions would probably be more discernible, let's say, on a given change that might be suggested in or nearby a community.

Q But isn't --

A It would be possible to probably gain opinion on a specific proposal. It's more difficult when you're looking at a generalized proposal such as the entire route, let's say, of the pipeline, than to try to gain an impression from an individual or a group about their opinion on the total impact is rather difficult.

But if you're looking at specific, let's say specifically a borrow pit located within Yellowknife, there may be some options there that would be more acceptable to local communities.

Q I can shorten this simply by saying -- you tell me if I'm wrong -- you do recognize the need for some kind of process to obtain the views of native peoples.

A The tradeoffs that are possible occasionally are not only visual but are related to land use, material sites and so forth, and there are choices, I think it's possible to.

Q But insofar as the views of the natives with respect to your particular area, you want to know what they are, you would find that useful.

A I think feedback is useful and it can be organized.

Q And the reason you want that feedback is to avoid imposing your views over views that may be quite alien to you.

A Well again now I think you're talking about native populations.

Q I'm talking about views that stem from different tastes and different cultures.

A There's quite a lot known about people's views. The great deficiency is in the native peoples in terms of their attitudes towards landscapes or their preferences for various

landscapes is their attitude towards change.

Q Right.

A That's not well-known. It's better known with southerners, if you want.

Q So insofar as you lack the views of the native organizations and native peoples, in your area of expertise, your program is somewhat deficient and lacking.

A I think the feedback would be useful and just as a further point I think from experience in the south it's most effective if the groups affected organized the process, though, themselves.

Q You don't have any proposal --

A No. If I was asked for a proposal I would suggest that we work through the available organizations and that they set up a proper sounding board so that we can communicate our information to them.

Q Can I ask you, Mr. Bouckhout, if the company has any plans to obtain the views of the native organizations and the native communities in this area?

WITNESS BOUCKHOUT: In regards to aesthetics specifically?

Q Well, in regard to aesthetics and the other areas, environmental areas as well.

A Yes, we certainly have a community liaisson program which could very easily incorporate this particular aspect in its scope of reference.

Q Will that be in operation in time for the input to have any influence on your decisions?

A Well, I hope so, it is in operation now with granted, limited success.

Q And I take it it's not addressing aesthetic problems?

A It hasn't been addressing aesthetic problems to date per se, no.

Q But Mr. Taylor may remedy that.

A He may very well do.

Q Is that acceptable?

A It certainly is acceptable if Mr. Taylor felt that this is a necessary part of his program, it certainly could be easily incorporated.

WITNESS TAYLOR: As I said earlier I think it could be applied to site specific projects, projects that can be illustrated can be located and relate to a community rather than to an individual, so that we can get some sort of consensus. As yet, the project isn't to that phase. I think as time goes on that again if the community groups desire this kind of information, I think it can be developed, and in cases where there are options

for aesthetic treatment, let's say, opinion could be gathered.

Q But generally speaking, I understand you, do I, that the initiative you're leaving for this input, you're leaving to the native groups themselves, to the communities themselves.

A Well, it has to be a joint situation, obviously. I think it would bear some pertinent thinking on the part of the consultants as to how it could be handled but I think it would be up to the individual community or affected group to decide if and when they might want to get involved.

Q I ask you now, Mr. Bouckhout, do you have a copy of the Pipeline Assessment Report before you? Turn to page 378 which deals with recreation areas and parks. You see that on page 378 certain examples of the conflict between the proposed pipeline development on the one hand and recreational uses on the other are set out.

WITNESS BOUCKHOUT: Yes.

THE COMMISSIONER: What page is that again?

Q Page 378, sir; and then a recommendation is made at the bottom of page 378 on the right-hand column which I've asked you to comment on. I would read it for the record:

"A review of all such sites and inter-actions by the applicant would provide a basis for assessing impact and identifying needs for

adjustments of pipeline facilities or
procecures for remedial measures."

Now, do you agree that is a concern that requires attention?

A Yes, it is a concern which requires attention and we had intended in fact to cover this particular type of concern in our socio-economic panel.

Q So that's something we can leave to them, is it?

A Yes, you could leave it to them.

Q Do you have any views now that would be useful?

A Any views on what, sir?

Q On this recommendation?

A I think it's a valid recommendation, as I said.

Q Do you propose accepting it and undertaking it?

A Well, we are in fact right now carrying out reviews of this very nature, reviews of different land use types relative to our present location, including such things as parks, picnic sites, scenic areas and so on.

Q Do you have any work report that we could have a look at?

MR. GIBBS: Well, Mr. Bouckhout has already said that it was going to be dealt with

by the socio-economic panel. I'm sure we can leave it at that.

MR. RYDER: Q So do I take it that you have reports that we can look forward to?

A I'm not aware of any reports. As I say, there is work ongoing there. But as to what stage it is, I'm not sure since I 'm not responsible for socio-economic matters.

THE COMMISSIONER: Well, anything that is reduced to writing that constitutes a study or report will have to be listed and made available when it's ready, so we can rely on Foothills to do that.

MR. RYDER: Now, just one of two questions for Mr. Claridge, if I may.

Q At page 26 and 25, the bottom of page 25 and the top of page 26 you indicate that construction of river and stream crossings at the top of page 26 will generally be done during the winter when the potential effects on fish will be minimal in most cases. Now, can I ask you where you obtained that advice?

A That statement is actually after consulting with Mr. Bouckhout and his biological advisors, and I think it has to some extent arisen out of inter-disciplinary communication during the previous summer's program of investigating river and stream crossings. I think that as far as the pin-pointing rivers and streams and so on, that would be referred to the upcoming panel.

Q Well, I take it, Mr. Bouckhout, is that your advice or is that the advice of your fish biologist?

A I think this is general advice and I think it's generally applicable. There are certain circumstances where this may not be applicable, however in those cases where a line would cross the various streams fairly close to their mouths, I think that would generally be an applicable statement.

Q I'm not a fish biologist, but listening to Dr. McCart I came to the belief that the problem with siltation is a problem which occurs in periods of low flow, which is the wintertime. Would you accept that?

A I would accept that on Dr. McCart's recommendation. I am not speaking as a fish biologist either.

Q And that the problem with siltation is not so much the degree of siltation which is carried in the body of the stream, it's the degree of siltation which settles on the bottom and has some impact on the eggs there, and the overwintering eggs

there and the organisims.

A Yes, if there are over-wintering eggs there from fall spawners, I suppose again this again is really a subject which would be more relevant to the biological panel than to the geophysical panel.

Q Well, I can bring it up again, but just as a general observation, it appears that statement that I quoted appears to be contradicted by the previous information we received about the impacts of siltation during the wintertime. Because it's in this panel's evidence, I wanted you to comment on that apparent contradiction.

A Well, I am afraid I really couldn't comment any further on that. I think, as I said, that in most parts of our route we cross the streams fairly close to the mouth and in doing so I would think that the potential areas where one might find over-wintering eggs of fall spawning fish is relatively low. I think you would probably find the eggs in spawning areas likely farther upstream, above the site of the pipeline crossing.

Q So, it is not the time of year that you are referring to when you say during the winter, it is the location?

A Well, in the winter, if the streams were crossed downstream from a spawning area, where there could potentially be over-wintering eggs, I don't believe there is any particular problem with crossing downstream.

Certainly, if it were crossing upstream there could be a potential problem. Again, I really don't feel qualified to speak to this particular issue.

Q All right. Can I ask you to look at the last sentence in questions 8. "Stream diversion would be made by means of a culvert or an excavated by-pass channel". Now, as a device for avoiding siltation, aren't there many other remedies that are more, are to be, that are to be preferred in that?

WITNESS CLARIDGE: For diversion

or are you thinking of something else, preventing siltation as such?

Q Well, I am getting at that a stream diversion would be made by means of a culvert of an excavated by-pass channel and I am worried about the technique of an excavated by-pass channel.

A This technique has been used in Alaska and I think it has been successful in the one or two instances that I am aware of.

Q And I take it the purpose of the technique is to maintain downstream flow, is it?

A I believe that is part of the purpose and also to permit the diversion of the water out of an area that would potentially have siltation effects that were not desirable.

Q Now, what you want to do is you want to maintain then downstream flow with the least amount of siltation possible?

A Yes, in the instance in Alaska, that I am aware of, this was part of the reason. The other part that there was a potential for siltation that the biologists decided was an unacceptable risk.

Q Right. Now wouldn't an excavated by-pass channel spew great quantities of muddy water into the downstream portion of the stream you are crossing?

A It depends what it is excavated in. In that case, I believe there was a

pre-existing meander bend that had gravel in it and it was simply a matter of directing it into that and protecting the entrance and exit that seemed to be satisfactory.

Q So, as a mitigation measure it would depend, its appropriateness would depend upon the availability of gravel or other material that wouldn't carry siltation?

A This is true that a method of protecting the by-pass would have to be arrived at, although I don't see that would be difficult. I think we would be talking about, generally, streams with a manageable flow and the by-pass area involved would be very small so I don't see that as being a difficult problem.

Q Well, now sir one last question on that. In Alaska, did you come across the mitigation technique of hoses pumping water from the upstream portion down to the downstream portion and causing the discharge to be placed on the perma frost mat some distance away from the stream so that it would filter through the mat before reaching the stream?

A No, sir I am not aware of that?

Q Well, now have you considered such a technique then at all?

A No, I don't think that we have specifically identified the problems to the extent that we would get into methods such as that. They are

somewhat unconventional.

Q So, in the meantime we are left with just one technique for crossing streams?

A Well as I said, until we had more specific instances. For example, we really don't have much in the way of drilling information at streams and river crossings in the beds and this would be the first type of information that we would have to gather before we were even able to design a pipeline crossing of a stream.

And I think to go one step further, and to try to manufacture a number of possibilities and it may be two or three steps down the road, I don't think it would mean a lot.

Q So, I take it that's an area that you have got under continual investigation?

A After we have further site information, I think the biologists would want to have more information about what they are trying to protect and the design people would have to know about the bed conditions and I am sure the hydrologists would want to know more about the hydrology of the streams before proposing more specific solutions.

Q So, when I suggest to you that the technique that I described of putting hoses in the upstream portion of the stream and pumping the water into the downstream portion, that method that I described, you didn't find that in Alaska?

A I am not aware of it.

Perhaps someone else on this panel has-- Often we relate to various contacts in Alaska and our sources of information are different. Myself, I have not heard of that technique, but perhaps someone else has here.

Q Can I ask you Mr. Bouckhout?

WITNESS BOUCKHOUT: Well, I personally wasn't aware of it either although it does sound like it has definite merit in certain circumstances. Particularly in wintertime.

Q That is all I have. Mr. Goudge has some questions.

CROSS-EXAMINATION BY MR. GOUDGE:

MR. GOUDGE: Mr. Marshall has distributed Dr. Banfield's testimony sir and the lawyers are all reading it insidiously to see what was said about them and I think perhaps Mr. Marshall will be letting us know about that later on. I just have--

MR. MARSHALL: I will let you know when you find out what it says.

MR. GOUDGE : Mr. Bouckhout could I begin with you. I just have one or two questions to ask you about borrow, if I may. First you are aware--

MR. GIBBS: Before my friend starts on this, I was waiting until we got to this gravel and borrow pit, Mr. Davison tells me that he inadvertently mislead in one respect to his evidence on either Thursday or Friday and would like to correct it before we start talking about gravel, if that's all right?

MR. GOUDGE: I would be happy with that.

WITNESS DAVISON: Yes, it had to do with the Parsons Lake area and I indicated that we went into a borrow pit area after we had carried out the DIAND gravel search and I indicated that we had found a much greater amount of material in that borrow.

Actually, the borrow, or that particular source did not have high quality material that had been desired by the client and we were, we found a lesser amount of gravel, but we did find, or it did have general fill. But the client did not want general fill, they wanted high quality material.

We subsequently were able to find a source that had not been identified on the DIAND search a few miles to the west and that source turned out to have better quality material than we had found in the Parsons Lake area during DIAND. This has satisfied the requirements for our client on that.

I just wanted to correct this one particular source, had lesser quality.

MR. GOUDGE: I take it that completes it Mr. Gibbs?

MR. GIBBS: Yes.

MR. BOUDGE: Mr. Bouckhout, let me address a couple of questions to you about borrow. I take it that you are aware of the pipeline quidelines and the concerns they raise about borrow?

WITNESS BOUCKHOUT: Yes, I am.

Q Yes, in particular the concern raised at page 18 and it talks about the desire expressed in the guidelines for the applicant to describe quantities and qualities of aggregate or borrow materials required and so on. And I take it your company, or Foothills is in the process of moving towards the satisfaction of those concerns?

A That is correct. They are proceeding with this particular aspect of the program.

Q Yes, in terms of the qualities of borrow that you look to need, I take it your spread sheets set out the quantities that you proposed to use by comparison with the quantities that you have found to be available in the specific area?

A Yes.

Q And when you were commenting last week as to percentages, percentages of borrow to be used as compared to borrow available, it was from those spread sheets that you were intending to take your calculations?

A It was the information gained from such sources and as I indicated at that time, the borrow material required for a replacement of ice ridge backfill and for certain slope stabilization procedures was not involved in those calculations.

Q Yes. Just so we will be absolutely certain. I have in front of me, a document which appears in Part Three of your application facilities, Sections D, E, F and G, construction spread 1B, a pull-out sheet which has on it borrow sources and shows the available quantities that your company says are available on that spread sheet and as well the requirements that you will need on that spread sheet.

A That would be available quantities in the particular pits which have been designated I believe as possible pits for own purposes.

Q Yes. I take it, you still take the position though that if one totalled the requirements set out on those spread sheets for the entire length of the route, one could devise an easy calculation to say what percentages of borrow you say is available, you propose to use.

A Well, I think I indicated when we discussed this that the figures I gave were very general and it was my own fault that I used what seemed to be very specific figures.

Q Well, do you rely on these figures?

A I rely -- we relied on

these figures to come to the figures which I did state last week.

Q Yes, we did a calculation that came out a little differently but if the mathematics are correct, you'd agree that if we start from these figures and worked through the mathematics we'll come out with the percentage of borrow you say is available that you will need?

A Yes, you would if you broke it down into the areas that I had done.

Q Well, we did it on the mainline as a whole -- totalling the sheets. That's acceptable to you too?

A It would be -- You'd arrive at a different figures than what I gave you exactly but you know, I'm sure if we both worked it the same way, we would come out with the same figures.

Q Yes. Our calculations just so you'll have them show that as a percentage of sources identified, you will need about 10% for general fill and 1% for concrete aggregate. Do those percentages ring true in your estimation without asking you to go through the mathematics?

A I would think they would be in the general range. Yes.

Q Yes. Dealing with the identification of location of borrow facilities on the alignment sheets can you tell us who it was specifically who made those locations?

A I'm not sure specifically. It would have been someone in the engineering department but I really couldn't tell you quite honestly specifically who did it.

Q I see. You have acknowledged, however, that there is further work on an ongoing basis concerning the extent of individual locations and the quality of borrow and so on?

A That's right. Work is planned in these areas. As I said before, it's not directly on our critical path to be done the last summer or this winter particularly but it is definitely on the path of something that has to be done obviously.

Q Yes. Can you tell us whether you have an individual or an individual department designated to do that task?

A I don't know who exactly is doing the work, quite frankly. Again it is someone in our own engineering department but I really couldn't tell you specifically who it is.

Q Would it help you if I asked who is your Gretchin Minning?

A No, I don't think it really would. I don't think we have a Gretchin Minning.

Q Is she broken down into a variety of -- ?

A I believe if you were to draw somewhat of a parallel and I don't know how valid a parallel it would be, it would be someone

like Milt Fawcett in our own department, in our own company rather.

Q Is it fair to say that the approach that Milt Fawcett and his associates will be using is close to if not identical to that we heard from CAGSL?

A I really couldn't say. I really don't know what approach he is going to be taking.

Q Is that because no approach has been decided upon?

A Perhaps, Mr. Claridge would comment on this. The geotechnical people are or will be involved in borrow sources.

WITNESS CLARIDGE: A I would butt in only as I heard Miss Minning's testimony. I thought it was excellent and I think that there would be a very similar approach to that taken by her firm and I might add one point, Klohn Leonoff/ were invited to submit a proposal for carrying out borrow investigations. However, I don't believe there has been any commitment given as to the timing, simply because it hasn't been considered to be one that is crucial to the timing of the project at this point so we would anticipate someone of Miss Minning's calibre to have an involvement and it would be done along a similar line to that which she did.

Q And I mean in asking that question, Mr. Claridge, the general approach to the

development of borrow facilities and their environmental implications.

A Yes, I think so.

Q Your answer goes that far?

A I'm sorry.

Q Your answer that you will be using a similar approach to Arctic Gas --

A It would be a similar approach and I think when it gets down to specifics that one would have to work out criteria to decide exactly where one draws the line. I think one example for instance, would be the Fort Good Hope esker that if it is Foothills' policy to stay out of the development area that I would presume that that esker would have to be given close thought as to whether it would be developed. These would be, I think, policies that would have to be set out in conjunction with Foothills.

Q One matter that occurs to me as being a difference in approach between Foothills and CAGSL arises from your application and Mr. Bouckhout I don't know whether to address this to you or to Mr. Claridge. It's at page 5D-4.6 of Volume, of Part Three, Sections D, E, F, and G. Would you just get that out, please?

WITNESS BOUCKHOUT: A 5D-5, is that?

Q 4.6

A I'm sorry you are going

to have to give me a little help here. I just can't really find that for you.

MR. GOUDGE: I will ask for a bit of help if you will bear with me for a moment. While we are locating the exact reference let me read it to you. It is a paragraph that deals with supplementary borrow material being obtained by dredging. It says:

> "Supplementary borrow material will be obtained by dredging of approved and viable locations in the Mackenzie River. Borrow will be placed or stockpiled on the east bank of the river near the dredge locations. Borrow will be hauled and placed at locations remote from the river in winter when snow and winter roads can be constructed for the stockpiles. Precautions will be taken to ensure minimal environmental damage to terrain due to drainage during dredging operations."

Having brought that to your attention, let me ask you this. Are you speaking there of dredging operations apart from the digging of the trench for the line through bodies of water?

A Yes. I believe in the application they were speaking of something apart from digging the trench in the bodies of water. I might add that we have had to place constraints on that particular type of attainment of borrow material in that

we had said by no means could borrow be obtained by that method from either gravel bars or islands in the river and so on which are known to be of import to staging water fowl and so on.

Q This then is not simply dredging or the use, the obtaining of borrow material incidental to dredging operations which would go on for the laying of the line?

A I believe that's correct. This is one of the areas of obtaining -- the methods of obtaining material that our engineering department has been considering.

Q Yes. I take it, it is still a viable alternative as far as your engineering department is concerned.

A I believe it is still a consideration. I don't really know how viable it is as yet.

Q Do you have any information for us now as to roughly how much of your spoil or borrow you will be intending to obtain in this manner?

A No, I don't. As I say --

Q Do you have any ballpark figure. That is, are we talking a large number or a very small percentage?

A I would think it would be relatively small percentage. If I am correct, the primary use for this borrow would be at local stockpile sites very close to the river but I really couldn't say

more than that.

Q Have any sites been selected where this is your first proposal for your developing borrow?

A Not to my knowledge. I'm not sure if our engineering or our construction panel spoke to this particular issue but to my knowledge, no specific sites have been designated. As I say, this is a potential alternative of obtaining such material.

Q Well, have any criteria been developed for where this would be permissible?

A Well, I've already mentioned a couple beyond that it would really be a site-specific circumstance.

Q Just so I'll have them again. What were the couple?

A The couple involved are taking of material from gravel bars and from areas very close to islands which could potentially affect the shorelines of the islands and the gravel bars and so on.

Q In those areas, dredging would not be permitted?

A That's correct.

Q Yes. Are you prepared to say that you would, if necessary, advocate dredging anywhere else under water? Are those the only two constraints?

A Those are the only two

that come to mind immediately. There could quite possibly be others but those are the two that come to mind immediately.

Q Yes. Your firm has no others presently on hand?

A No, we don't. We have as I say, it is an alternative and we haven't looked at any specific sites per se. I am not sure what the viability or the present thinking of viability of this particular alternative is right now but since we haven't designated any sites, we have not implied or imposed any further constraints as yet until the viability of this particular type of alternative is improved.

Q I take it, it's your view that this is not a highly viable alternative?

A It has potential. I really couldn't speak to the engineering or construction viability of it. It certainly has potential that's close access to material for local stockpile sites. I couldn't say much more than that.

Q Has your firm or any of your consultants addressed themselves to the potential environmental impacts of this technique?

A Beyond the constraints I've already mentioned, we really haven't done any further on it. It's really in a preliminary stage.

Q Nor have you addressed yourselves, I take it, to any mitigative measures that might be taken to alleviate those impacts?

A That's correct. Well, I believe they have. Our Engineering Department in looking at this has mentioned such things as possibly dykes or something to control siltation if the material is in a slurry form when it's brought up or something, but you know, I'm not too up-to-date on that.

Q Do you know if work is going ahead to develop this as a viable alternative?

A I don't believe there's anything being attively pursued on it to my knowledge.

Q Perhaps, Mr. Gibbs, you'll advise us if work is going ahead on that as a viable alternative. Until that happens I can at the moment leave it where it is. Was that a "Yes", Mr. Commissioner, I didn't --

MR. GIBBS: Yes, I'm trying to find Dr. Banfield's reference to lawyers but I intended to say "Yes".

MR. GOUDGE: Now if I can move

to questions arising out of your evidence. As I understood your evidence, though I must say I wasn't here to hear it in chief, but the objective of the program you devised for your client is to help restore a self-supporting ecosystem along the right-of-way.

WITNESS VAARTNOU: That's correct.

Q Now, could I ask you to recite for me what you think the environmental consequences would be if there were no revegetation program?

A It means something would be completely unnatural. It does not fit into the environment, natural environment at all, and if we cannot establish a self-supporting ecosystem, the erosion in certain areas would be quite bad.

Q I suggest to you that the second point you make, the erosion problem is the primary environmental consequence that will arise if one does not revegetate.

A Yes it is right, but to correct that we need the self-supporting ecosystem, and that could take care of the erosion as much as we can control it through the vegetation.

Q Yes. The aim, though, of revegetation is to control erosion and restore surface stability.

A That's right, through self-supporting ecosystems.

Q Would you be happy if

erosion could be controlled and surface stability restored without the necessity of exactly replacing the native ecosystem?

A You never can replace native ecosystems, and impossible to do it.

Q When you refer to the phrase, Dr. Vaartnou, of "self-supporting ecosystem", and that is your aim, as I understood it, what do you mean by that?

A Self-supporting ecosystem, if we consider the nitrogen cycle, we consider the carbon cycle as going on in nature all the time, it means it has to be equilibrium established between the environment, plant community, and soil, micro-organisms and soil specifics.

Q So that for a self-supporting ecosystem in the boreal forest area would be that, a boreal forest.

A What you mean "a boreal forest"? Do you consider only the forest aspect? Do you consider the ground cover? Do you consider the micro-flora within the ground? What do you consider as boreal forest? I consider this all as a boreal forest ecosystem.

Q I'm sorry.

A Not only the trees.

Q I'm sorry, I didn't understand what you just said. Could you --

A I conider all those

factors -- soil, living part -- I mean organic living and inorganic parts of the soil, vegetation, including all, and environment.

Q Yes. Let me ask it this way, doctor --

THE COMMISSIONER: Before you go on, I was interested in your reply but I somehow lost the question. What was the previous question?

MR. GOUDGE: I wish I knew, sir. I was so interested in the reply I --

MR. GIBBS: He asked whether a boreal forest was not a self-supporting ecosystem and Dr. Vaartnou answered it.

MR. GOUDGE: He answered it with a question and then I think responded.

THE COMMISSIONER: Yes, he did. Well, the question wasn't terribly profound, now that we --

(LAUGHTER)

MR. GOUDGE: It's good to be back. I'm hunting for a better question.

THE COMMISSIONER: Well, just before you go, Dr. Vaartnou, the big dispute between Arctic Gas and Foothills regarding revegetation is the use which Arctic Gas urges of agronomic species and varieties for revegetation, and the insistence by Foothills upon revegetating with natural and naturalized species and varieties. Maybe "naturalized" is not the right word to use, but at least you know what I mean.

I got the impression, and I want you to correct me if I'm wrong, but you felt that the natural varieties had established their capacity to resist the diseases and survive in the cold; you were not at all convinced that the agronomic varieties would do so. Did I get that right or --

A That is correct.

THE COMMISSIONER: Well, I won't say anything more then.

MR. GOUDGE: Let me ask you this, Dr. Vaartnou, about the native species. Is it your feeling that they will generate as quickly as the agronomic species that Arctic Gas proposes to use?

A Native species, we have to separate some smaragd, bunch type, creeping type, and some of them are very fast established, some take two, three years like calamagrostis or Arctagrostis before they are really established. If you go to species like poa polustris, some of them native fescues, or some of the native bromes, special ecotypes, they could and will establish as fast as any introduced species, or introduced varieties, agricultural varieties.

Q I take it that when you assert they could and would establish themselves as quickly, you say that acknowledging that you have not yet tested their viability north of the 60th Parallel?

A I've seen them growing and I've seen them growing on environments simulated

to the northern environments, and in comparing the germination, how fast it germinates, and their development, I know that the ecotypes of native species could do as fast as any introduced variety. And beside that, if I'm talking naturalized landraces, these are the same species and if they are established that means that nature has helped to select them in local environment conditions, why should they be slower than the introduced varieties?

Q Would you agree with me that if they do turn out to be slower, in generating than the introduced species, they will not serve the purpose of erosion control as well?

A I don't agree with that, though. Native varieties used in a northern environment are much more profuse, regulative and vegetative growing heavy than most of the introduced varieties or agricultural varieties. They don't produce so much seed and in certain environm ent conditions they don't produce seed at all. But that doesn't mean that they are less suitable for erosion control. In my estimation they are more suitable for erosion control than varieties introduced susceptible to disease and don't survive more than half a winter, so they would go out. First winter disease is severe; but native varieties may be they don't produce so much hay, but they produce more surface cover, they produce more root system that could help more erosion control than any high hay crop can do it.

Q And you would say that even if you assumed with me that they did not grow as quickly as introduced species --

A That's correct, because they are established in the northern environment and northern environment itself usually makes the plants growing slower in certain aspects.

Q One other aspect of the program that you spoke of intriques me, Dr. Vaartnou. Question 13 of your evidence in chief you say, as I understand you, that your program will involve aerial seeding, ground seeding using seeders, harrows, rollers and other equipment, and certain vegetative methods such as shredding and root-cuttings. I understood that correctly, did I?

A Correct, but there are other vegetation methods that we're going to use, planting, seedings grown for that purpose, and rooted cuttings.

Q Planted seedlings and what?

A I would plant seedlings grown for that purpose. If I say it's some like native rust but we know what we can grow, grow cuttings like alder and as much as I know we can very little propogate that species with native nitrogen, collecting material that's very important for the self-supporting ecosystem in the north, it is verv important that that species could be re-introduced to the slopes.

(MR. VAARTNOU CONT'D)

To me, this is very important. We can't do it any other way. We have to establish seedlings. We have to grow it from seeds and then plant the seedlings to the certain environmental conditions like very sandy slopes, stabilization point of view where we cannot do anything else. The other shrubs have to be handled the same way.

Q Well seedlings-- The planting of seedlings is then another way. Let me ask you, given this variety of methods that your program of re-vegetation contains. Do you propose to develop a manual for employees of the re-vegetating companies to use given this variety of techniques that they will be asked to employee?

A I expect a man who is in charge of the re-vegetation to know those techniques and would be ready to handle that approach.

Q And I take it your manual would have to include criteria as to when you used-- Sorry.

MR. GIBBS: He didn't say a manual, he said a man in charge.

Q Well a man in charge would have to be prepared to know how to choose any of these specified methods?

A Yes.

Q Yes. And criteria would have to be developed to quide that man in his choices?

A Yes, I expect the man to be trained before some proper agriculture school and then he should be specifically trained for the northern application in northern areas, what is necessary.

Q And does that training extend to the crews of men he might have working for him engaged in re-vegetation?

A Yes, I expect they should be familiar with what they are doing.

Q Yes, and in so far as the supervision of those men is concerned, would you consider that the supervision of the crews would require agricultural college experience?

A I don't know but as I mentioned that the man who is in charge of that type of thing, besides the knowledge and technique, he needs some kind of green thumb or he has to be a successful farmer.

Q You have already got one.

A If the man is in charge and if he wants that program to be responsible to him, what he wants to do there, I don't think that is enough if the man in charge starts to do those plans in any language, I've had quite a few of them, but I have not the plans to respond to any language but they respond if you love them. I learned that from my wife.

THE COMMISSIONER: Any further

questions?

Q I just have one or two more sir. Having passed the appropriate place to end, let me just ask one or two more questions Dr. Vaartnou. You said in answer to Mr. Carter's questions last week, as I took it, that you have not yet tested the seeds you propose to use north of the sixtieth parallel?

A Not in that sense, yes, because if I start that program or project I do it starting first after survey, then select, then study the material in uniformity garden, then try to produce the seed, then I am ready to go back to test them in an environment where it is going to be used.

Q And that's the point your at now?

A Yes, I am at that point and I expect this winter I am advising the Foothills company the site should be selected this winter and then ready to start the research work on treeless tundra area or tundra area and some other areas to test the material.

Q Yes. This winter is your first crutial winter but I took it from your evidence that your test program will run over three years?

A Yes, I expect the preliminary report to be available after three years testing.

Q So, it may be three years before you can be sure that your program,using seeds, at least, will be successful?

A Yes, I would be sure then

but I could visualize the materials collected from the actual environment should be as good as any other material.

Q And as, in so far as the process of shedding is concerned, as well I think you acknowledged that that process has not been tested north of the sixtieth parallel?

A Not, exactly. The main point there is to harvest the material. I could visualize that there would be three types of areas. One, unsaturated, then saturated, then over-saturated layers on the dirt tundra area. I could visualize that only the unsaturated layer containing on the surface growth of the shrubs, local shrubs and two to four inches of the soil can be used easily for that purpose.

Q And I take it, you advised your client that a testing program for shredding ought to begin this winter?

A That's correct.

Q And have you in fact designed such a testing program?

A Yes and no. Not final, but preliminary design is done.

Q Yes. Where will your tests be conducted?

A I don't know yet. I would like to test that in treeless tundra, then south and right close to maybe the Yellowknife area or somewhere near.

Q And will they be conducted

during the winter?

A Yes, it would be started but it would be carried out in maybe three different time zones, winter, spring and fall because I want to find out exactly when-- We are all ready doing it in the grow chambers and we started all ready last fall in Edmonton areas using native shrubs for that purpose but in the north we would like to do it in the areas that I mentioned.

Q I take it you would have though, to do the shredding procedure in the winter because it will be done if used on site in the winter?

A Yes, if it is used, if we can do the shredding directly when we pick it up, there are possibilities that we have to use special shredding machines later on in the spring. If the clumps was coming up in the winter, it was too large for proper installation or planting.

Q So I take it, you would, in fact, contemplate using shredding in the construction process long after the winter construction season is over.

A Not necessarily. If the area is ready, we could put apply the material direct to that area where the pipelaying is completed and then we could incorporate using maybe the ditch rollers or corrugated rollers that do get the material incorporated on the loose surface before it is -- it would be sealed up.

Q Now, this testing process you envisage for shredding, Dr. Vaartnou, again I think you said it will take three years before you can be sure of its viability?

A No, not necessarily. I see it first growing season if it is growing it or not. If I do it this winter, whenever the first growing season starts in the springtime, I know if the plant's growing or not.

Q I see, so you say for that, a one year time span is sufficient?

A Yes. But I would like to expect that we could carry on more because so many aspects might be economically more reasonably than I first could visualize.

Q I see. I take it though, from the mere fact, that you've proposed testing for both your seeding procedure and your shredding

procedure that you must contemplate the possibility now that neither seeding nor shredding will prove satisfactory?

A I guess say you want to con -- what I would like to do then if nothing that will grow there, --

Q Well, if you'll say yes to that, then I will ask you that question.

A I guess I replied to that one.

Q Pardon.

A I replied to the same question Friday.

Q Yes. And I just want to ask you whether you were serious with that reply. I wasn't here to see you but I read it.

A I don't think it would be economical.

Q You don't think it would be economical to put artificial turf or any other kind of turf up and down.

A No, I don't think so.

Q Do you have any fall-back scheme to use if seeding and shredding prove unviable?

A If the plant doesn't grow, then there is nothing that can be done. There must be some way a plant -- one way, or other way, we have to get the plant growing there.

Q No, but is it fair for

me to say that your position is that you are confident seeding or shredding will work and that you have no other fall-back position?

A Yes, I am.

Q Thank you, sir. Those are all the questions I have. Oh yes. One last question that I was asked. Sorry. And this is really a proforma question. The re-vegetation scheme that you put forward to us here, sir. I take it you've recommended to your client.

A Yes.

Q And is there someone on the panel who can indicate whether the client has accepted it as a proposal for re-vegetation?

WITNESS BOUCKHOUT: A Yes, Dr. Vaartnou has been hired by Foothills to provide suggestions, recommendations, with regards to the re-vegetation program and we have been following his advice along those lines. In fact, to the point where as Dr. Vaartnou has already indicated, we are prepared to support the propogation of seed for this particular purpose.

Q Thank you, sir. Those are all the questions we have at this time.

THE COMMISSIONER: Any re-examination?

MR. GIBBS: No, sir.

THE COMMISSIONER: Well that completes the evidence of this panel then and I want

to thank you, Mr. Bouckhout, and your colleagues for being as patient with us as you have been and we all appreciate receiving the benefit of your knowledge and experience. You are all excused and you can get aboard that flight tonight.

(WITNESSES ASIDE)

THE COMMISSIONER: I think that that completes Phase Two, doesn't it, Mr. Goudge?

MR. GOUDGE: Yes,sir, it does and we look forward to Phase Three at 8:00 tonight, sir?

Oh, I should say that it completes Phase Two on behalf of the pipeline companies. We may find ourselves hearing evidence relevant to some of these topics from certain of the interveners and from ourselves later in December.

MR. MARSHALL: Mr. Commissioner, just before we break there is one matter that I would like to raise. Firstly, I would like to apologize for having Dr. Banfield's evidence distributed so late. It came about for the reason I explained last week. Namely, Dr. Banfield being away. I had indicated or in the prepared evidence for the third panel, the panel in Phase Three indicated on page 67 in parentheses that Mr. Jakimchuk will elaborate on interactions with caribou as part of a slide presentation. Mr. Jakimchuk has indeed prepared a slide presentation, sir, to deal with interactions with caribou. He has gone beyond that, sir, in that, in addition to having prepared some slides and a few brief remarks on it, he has prepared a more detailed analysis of impact potential

of the Arctic Gas pipeline and the Porcupine caribou herd. He has just completed work on these today and I have had copies of it made.

Now, sir, there are several ways it could be handled. I realize that if it were to go in as part of his direct evidence, that would violate the rule about the twenty days' notice and I think that if there would be any objection to that, I would not proceed on that basis. I would not have Mr. Jakimchuk present this as part of his direct evidence.

If it's intended that there be a debate dealing with these subjects, Mr. Jakimchuk would, I'm sure, intend to rely on much of the information in the paper.

THE COMMISSIONER: You mean the debate among the environmentalists.

MR. MARSHALL: Yes, of the type that you were discussing last week, sir. Or alternatively it's a matter that I'm sure he will, he could address in rebuttal evidence. Well, I am really in your hands and those of the other counsel, sir, about it. I have it prepared. It seems to me that counsel may find it of some use to in preparing their cross-examination or in their own witnesses preparing themselves to give evidence in this phase. And for that reason it might be useful to have Mr. Jakimchuk present it as part of his direct.

If that creates any problems for any of my friends, I agree that it doesn't

comply with the rulings and I am prepared to not introduce the matter now.

THE COMMISSIONER: Well, let me tell you my feeling about this subject to what all of the other lawyers may say.

The question of the impact of the proposed pipeline, if it is built, on the Porcupine caribou herd, is a vital one.

If Dr. Jakimchuk has prepared this study on the likely impact , I could hope that he could give it tonight as part of his direct testimony, and that counsel would have the right to call upon you to bring him back for cross-examination at a later -- on a later occasion than his appearance this week on this panel, and in that way counsel would be given an opportunity, if they didn't have enough time to prepare their cross-examination, to do so and we could bring him back later on.

MR. MARSHALL: I'd be prepared to undertake to recall him, sir.

MR.GOUDGE: On a quick canvas of head nodding, sir, I think it would be the consensus of counsel that we would be anxious to hear it to-night, it seems to make sense to go in as part of his evidence in chief. You will remember, sir, that with this panel, as with its predecessors, we propose to segment the cross-examination. I think the large animal portion of that cross-examination may come some distance down the road, that is perhaps close to two weeks, given that we have a week's break anyway. So I think nobody will be prejudiced if the evidence is read in in chief tonight as part of Mr. Jakimchuk's presentation.

MR. GIBBS: I am content that should be so. Is that subject completed, sir, because I have another one I wanted to raise?

THE COMMISSIONER: I think it's

completed.

MR. GIBBS: I think I have an understanding with my friend, Mr. Marshall, that Mr. Dau will be produced Thursday afternoon to be cross-examined on the evidence that he gave at Whitehorse with respect to the cost figures and so on, on the Fairbanks corridor, if that's satisfactory to you, sir, to insert him that afternoon to complete that--

THE COMMISSIONER: Which afternoon?

MR. GIBBS: Thursday afternoon, sir.

THE COMMISSIONER: Certainly.

MR. GOUDGE: While we're all reminding each other of things like that, sir, I have been asked if Mr. Marshall is in a position to give us any further information on helicopters and airplanes in connection with construction spreads. That is going to become of central relevance in Phase 3.

MR. MARSHALL: Yes, I must apologize, Mr. Goudge, there is a report that I believe has this information. I haven't had a chance to look at the report. From its title I would take it that it includes some of this information and we have a copy of it in the office. I confess to being derelect in getting out a revised or supplemental list of reports. I just simply haven't been able to get to it. I'm working on it, and I hadn't realized that you wanted it so quickly, but that particular report, I think, will answer the questions that you're interested

in and can be obtained in our office here.

MR. GOUDGE: Thank you, sir.

THE COMMISSIONER: All right, we'll adjourn until eight o'clock.

(PROCEEDINGS ADJOURNED TO 8 P.M.)

MACKENZIE VALLEY PIPELINE INQUIRY

IN THE MATTER OF APPLICATIONS BY EACH OF
(a) CANADIAN ARCTIC GAS PIPELINE LIMITED FOR A RIGHT-OF-WAY THAT MIGHT BE GRANTED ACROSS CROWN LANDS WITHIN THE YUKON TERRITORY AND THE NORTHWEST TERRITORIES, and
(b) FOOTHILLS PIPE LINES LTD. FOR A RIGHT-OF-WAY THAT MIGHT BE GRANTED ACROSS CROWN LANDS WITHIN THE NORTHWEST TERRITORIES,
FOR THE PURPOSE OF A PROPOSED MACKENZIE VALLEY PIPELINE

and

IN THE MATTER OF THE SOCIAL, ENVIRONMENTAL AND ECONOMIC IMPACT REGIONALLY OF THE CONSTRUCTION, OPERATION AND SUBSEQUENT ABANDONMENT OF THE ABOVE PROPOSED PIPELINE

(Before the Honourable Mr. Justice Berger, Commissioner)

Yellowknife, N.W.T.

November 17, 1975.

PROCEEDINGS AT INQUIRY

Volume 88-A

ALLWEST REPORTING LTD.,
4299 CANADA WAY,
BURNABY 2, B.C.

APPEARANCES:

Mr. Ian G. Scott, Q.C., Mr. Stephen T. Goudge, Mr. Alick Ryder and Mr. Ian Roland	for Mackenzie Valley Pipeline Inquiry;
Mr. Pierre Genest, Q.C., Mr. Jack Marshall, and Mr. Darryl Carter	for Canadian Arctic Gas Pipeline Limited;
Mr. Reginald Gibbs, Q.C., Mr. Alan Hollingworth & Mr. John W. Lutes,	for Foothills Pipe Lines Ltd.;
Mr. Russell Anthony & Pro. Alastair Lucas	for Canadian Arctic Resources Committee;
Mr. Glen W. Bell and Mr. Gerry Sutton,	for Northwest Territories Indian Brotherhood, and Metis Association of the Northwest Territories;
Mr. John Bayly or Miss Leslie Lane	for Inuit Tapirisat of Canada, and The Committee for Original Peoples Entitlement;
Mr. Ron Veale and Mr. Allen Lueck	for The Council for the Yukon Indians;
Mr. Carson H. Templeton,	for Environment Protection Board;
Mr. David Reesor	for Northwest Territories Association of Municipalities;
Mr. Murray Sigler	for Northwest Territories Chamber of Commerce.

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WITNESSES FOR CANADIAN ARCTIC GAS PIPELINE LIMITED:

Dr. Frank BANFIELD
Donald DABBS
Alex HEMSTOCK
Ron JAKIMCHUK
Peter McCART
Bill GUNN
- In Chief 13354

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(PROCEEDINGS RESUMED PURSUANT TO ADJOURNMENT)

MR. GIBBS: Mr. Commissioner, I have a number of requests which have been made, and I thought, if it was in order, I would refer to each one and Miss Hutchinson has a copy of all of them and she could perhaps mark them in order as I make reference to them, then we will distribute them after they have all been marked.

THE COMMISSIONER: Thank you.

MR. GIBBS: Firstly, sir, I believe this becomes Exhibit 313 -- 314, at transcript reference, page 8656, Mr. Marshall requested a report on compressor station No. 14 gas heaters.

(REPORT ON COMPRESSOR STATION NO. 14 GAS HEATERS MARKED EXHIBIT 314)

MR. GIBBS: Nextly, Exhibit 315, transcript reference, page 8676, Mr. Marshall requested information on the location of compressor station No. 1.

(INFORMATION ON LOCATION OF COMPRESSOR STATION 1 MARKED EXHIBIT 315)

MR. GIBBS: Then, sir, 316, at transcript reference page 8696, Mr. Scott requested information concerning the temperature profile along the Yellowknife lateral.

(INFORMATION RE TEMPERATURE PROFILE ALONG YELLOWKNIFE LATERAL MARKED EXHIBIT 316)

MR. GIBBS: The next Exhibit 317, transcript reference page 8760, Mr. Marshall requested confirmation of calculated scour depth of cover at the east channel crossing of the Mackenzie

River.

(SCOUR DEPTH OF COVER AT EAST CHANNEL CROSSING OF MACKENZIE RIVER MARKED EXHIBIT 317)

MR. GIBBS: Exhibit 318, transcript reference page 8770, Mr. Marshall requested two interim reports on the mathematical model.

(INTERIM REPORTS ON MATHEMATICAL MODEL MARKED EXHIBIT 318)

MR. GIBBS: Exhibit 319, transcript reference page 8786, Mr. Marshall requested Dr. Glockner's report made to E. Mirosh on his review of the application material on stress design.

(DR. GLOCKNER'S REPORT TO E. MIROSH MARKED EXHIBIT 319)

MR. GIBBS: Exhibit 320, transcript reference page 8818, Mr. Bayly's request for a report relating to pipelines attached to bridges.

(REPORT RE PIPELINES ATTACHED TO BRIDGES MARKED EXHIBIT 320)

MR. GIBBS: Exhibit 321, transcript reference page 8960, Mr. Scott requested a study of Foothills' communication system by C.N. Telecommunications.

(FOOTHILLS' COMMUNICATION SYSTEM BY C.N. TELE-COMMUNICATIONS MARKED EXHIBIT 321)

MR. GIBBS: Exhibit 322, transcript reference pages 9030 and 9031, Mr. Marshall requested production of the internal memorandum outlining the results of detailed sound surveys at A.G.T.L. compressor stations.

(INTERIM REPORT RE SOUND SURVEYS AT A.G.T.L. COMPRESSOR STATIONS MARKED EXHIBIT 322)

MR. GIBBS: Exhibit 323, transcript reference 9061, Mr. Scott requested information on sites where helicopter transportation will be used.

(INFORMATION ON SITES WHERE HELICOPTER TRANSPORTATION WILL BE USED MARKED EXHIBIT 323)

MR. GIBBS: Exhibit 324, transcript reference page 9062, Mr. Scott requested information on sites where operation and maintenance would use snow roads.

(INFORMATION ON SITES WHERE O. & M. WOULD USE SNOW ROADS MARKED EXHIBIT 324)

MR. GIBBS: Exhibit 325, at transcript reference page 9063, Mr. Scott requested information on the size and type of helicopters to be used.

(INFORMATION ON SIZE & TYPE OF HELICOPTERS MARKED EXHIBIT 325)

MR. GIBBS: Exhibit 326, transcript reference pages 9101 and 9102 Mr. Scott requested that we make available the study which examines how far noise will carry from specific compressor stations.

(STUDY RE NOISE FROM COMPRESSOR STATIONS MARKED EXHIBIT 326)

MR. GIBBS: Exhibit 327, transcript reference page 9109, Mr. Scott requested that we produce the report identifying the special

community or wildlife concerns which would necessitate extra noise attenuation at compressor stations.

(REPORT IDENTIFYING COMMUNITY OR WILDLIFE CONCERNS RE NOISE AT COMPRESSOR STATIONS MARKED EXHIBIT 327)

MR. GIBBS: Exhibit 328, transcript reference page 9112, Mr. Scott requested that we produce when available a report on the effects of emission concentrations on wildlife and vegetation.

(REPORT ON EFFECTS OF EMISSION CONCENTRATIONS ON WILDLIFE & VEGETATION MARKED EXHIBIT 328)

MR. GIBBS: Exhibit 329, transcript reference pages 9198 and 9199, Mr. Marshall requested the information on toughness properties of A.G.T.L. 503 wall pipe.

(INFORMATION ON TOUGHNESS OF WALL PIPE MARKED EXHIBIT 329)

MR. GIBBS: Exhibit 330, transcript reference pages 9185 and 9188, and also 9223 and 9224 Mr. Marshall requested data on pipe price fluctuation.

(PIPE PRICE FLUCTUATION DATA MARKED EXHIBIT 330)

MR. GIBBS: Exhibit 331, transcript reference pages 9320 and 9323, Mr. Marshall requested a report entitled:

"The Effects of Water Seepage on Prediction of Ground Thermal Regime dealing with the moisture migration study and its effect on the computer model."

(REPORT RE WATER SEEPAGE MARKED EXHIBIT 331)

MR. GIBBS: Exhibit 332,

transcript reference pages 9324 and 9326, Mr. Marshall requested two articles written by Francis Yip entitled:

"Prediction of Frost Formation around a chilled natural gas pipeline," and

"Computer simulation of the thermal regime of continuous and discontinuous permafrost."

(2 REPORTS BY F. YIP MARKED EXHIBIT 332)

MR. GIBBS: Exhibit 334, transcript reference, page 9347, Mr. Marshall requested information concerning geotechnical aspects of a possible cross-delta route. That's not part of this filing as it's already been responded to by Mr. Hollingworth so I am in error in saying Exhibit 334, sir.

Exhibit 334 is transcript reference, pages 9411 and 9414, Mr. Bayly requested a report entitled:

"Environmental Impact Assessment, Water, Mackenzie Gas Pipeline on stream gauging."

(REPORT RE ENVIRONMENTAL IMPACT ASSESSMENT WATER MACKENZIE GAS PIPELINE ON STREAM GAUGING MARKED EXHIBIT 334)

(COMPUTER SIMULATION OF THERMAL REGINE OF CONTINUOUS & DISCONTINUOUS PERMAFROST MARKED EXHIBIT 333)

MR. GIBBS: Exhibit 335, transcript reference pages 9550 and 9552. Mr. Scott requested drawings of two samples used in the design of erosion and drainage control devices.

(THE DESIGN OF EROSION AND DRAINAGE CONTROL DEVICES MARKED EXHIBIT 335)

MR. GIBBS: Exhibit 336, transcript reference pages 9562 and 9564. Mr. Marshall requested a report concerning Mr. Claridge's drainage study.

(REPORT CONCERNING MR. CLARIDGE'S DRAINAGE STUDY MARKED EXHIBIT 336)

MR. GIBBS: Exhibit 337, transcript reference pages 9575 and 9582. Mr. Scott requested the Klohn Leonoff Report on construction safeguards to counteract possible disturbance to the terrain.

(KLOHN LEONOFF REPORT ON CONSTRUCTION SAFEGUARDS TO COUNTERACT POSSIBLE DISTURBANCE TO THE TERRAIN MARKED EXHIBIT 337)

MR. GIBBS: Exhibit 338, transcript reference pages 9686 and 9687. Mr. Geneste requested estimates of cost and borrow for the construction of gravel roads along or on the right-of-way.

(ESTIMATES OF COST AND BORROW FOR THE CONSTRUCTION OF GRAVEL ROADS ALONG OR ON THE RIGHT-OF-WAY MARKED AS EXHIBIT 338)

MR. GIBBS: Exhibit 339, transcript reference page 9783. Mr. Bayly requested an opinion as to whether the material pulverized as a

consequence of blasting would be sufficiently fine to properly re-vegetate.

(OPINION AS TO WHETHER THE MATERIAL PULVERIZED AS A CONSEQUENCE OF BLASTING WOULD BE SUFFICIENTLY FINE TO PROPERLY RE-VEGETATE MARKED AS EXHIBIT 339)

MR. GIBBS: Exhibit 340, transcript reference page 9932. Mr. Scott requested that we provide reports supporting the proposition that exposing the right-of-way prior to construction will not result in degradation.

(REPORTS SUPPORTING THE PROPOSITION THAT EXPOSING THE RIGHT-OF-WAY PRIOR TO CONSTRUCTION WILL NOT RESULT IN DEGRADATION MARKED AS EXHIBIT 340)

MR. GIBBS: Exhibit 341, transcript reference page 9975. Mr. Scott requested Foothills proposed methods for disposition of the pipeline test media.

(FOOTHILLS PROPOSED METHODS FOR DISPOSITION OF THE PIPELINE TEST MEDIA MARKED AS EXHIBIT 341)

MR. GIBBS: Exhibit 341-- Exhibit 342, transcript reference page 10084. Mr. Scott requested the reasons why West Coast proposes ten block valves in a 140 mile section compared to each Foothills initial or proposed compressor station site.

(REASONS WHY WEST COAST PROPOSES TEN BLOCK VALVES IN A 140 MILE SECTION COMPARED TO EACH FOOTHILLS INITIAL OR PROPOSED COMPRESSOR STATION SITE MARKED AS EXHIBIT 342)

MR. GIBBS: Exhibit 343,

transcript reference page 10111. Mr. Scott requested estimated annual tonnages in operations and maintenance.

(ESTIMATED ANNUAL TONNAGES IN OPERATIONS AND MAINTENANCE MARKED AS EXHIBIT 343)

MR. GIBBS: Now sir there are still some outstanding responses that perhaps I could report on. I believe these are the only ones still outstanding.

One that I have yet to look into because I don't understand the explanation. I am told Mr. Marshall requested information on the soundings for the east channel crossing in the vicinity of Swimming Point and I was told that these couldn't be released for proprietory reasons and I have to check on what that means and I will advise you further.

The other requests I think are still outstanding sir, are these: Mr. Bayly requested a report on pipe coatings. That will be available later this winter. Mr. Marshall requested information on the effect of consolidation of the various soils along the Foothills route. That report will be available in December. Mr. Bayly requested information on the downstream effects of the pipeline on fish spawning and that will be dealt with by the biological panel. Mr. Bayly requested a report concerning possible changes to the composition of the material converting the pipe and stream crossings and that will be available in the beginning of 1976. Mr. Geneste requested detailed geotechnical studies which will serve as a basis for

preparing estimates of where Foothills will utilize blasting, concrete weights and backfill for buoyancy control and that report or study will be available on December 31. Mr. Bayly requested a procedure manual for construction workers and I am told that will not be available until the time of tender on construction contracts. Mr. Geneste requested that the report on snow roads being prepared by Mr. Jarvis, that will be available at the end of this month. Mr. Scott requested some information concerning restoration matters. That report is in preparation and I am unable to say when it will be ready sir.

THE COMMISSIONER: Thank you very much Mr. Gibbs.

MR. GIBBS: I had omitted earlier in the day to introduce Mr. Philip Kingston who is anchor man in the Foothills organization responsible for producing all these responses and the prepared evidence and reading the transcripts and other of those type of duties.

THE COMMISSIONER: Welcome Mr. Kingston.

MR. MARSHALL: Thank you sir. Mr. Commissioner we are ready to present the direct evidence of the Arctic Gas panel pertaining to phase three, "Impact of the pipeline on living environment". The members of the panel are Mr. Alex Hemstock, Mr. Don Dabbs, Dr. Peter McCart, Dr. Bill Gunn, Mr. Ron Jakimchuk and Dr. Banfield. All of the panel members have previously given evidence before the inquiry with

the exception of Dr. Gunn. Of the other members you will recall that Mr. Jakimchuk was an overview witness and the others have appeared on various panels. I would like to review with Dr. Gunn, his qualifications. Miss Hutchinson has already sworn him sir.

Dr. Banfield
Mr. Don Dabbs
Mr. Alex Hemstock
Mr. Ron Jakimchuk
Dr. Peter McCart, resumed
Dr. Bill Gunn, sworn

(DIRECT EXAMINATION BY MR. MARSHALL)

Q Dr. Gunn, what is your present position?

WITNESS GUNN: My present position is president of L.G.L. Ltd., Environmental Research Associates.

Q Sir, would you review your educational background.

A I obtained a Bachelor of Commerce from the University of Toronto in 1934 and then a P.H.D. in zoology also at the University of Toronto in 1951.

Q What are your professional affiliations sir?

A I am an elected member of the Americal Ornithologists Union. Member of the Federation of Alberta Naturalists and a Trustee of the Nature Conservancy of Canada.

Q Dr. Gunn would you review your professional experience?

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A Well, after 1934 I did accounting work and public relations work until 1941. Then I enlisted in the Royal Canadian Ordnance Corps and retired from the army in 1946. From then until 1950 I was at the university. From 1950 to 1952, I was a biologist with the Division of Research, Ontario Department of Lands and Forests. In 1951 I became director of Wildlife Research Station in Algonquin Provincial Park.

In 1952, I became the first executive director of the Federation of Ontario Naturalists, and secretary of the Conservation Council of Ontario. At the Federation of Ontario Naturalists I began producing the series of long-play records under the title of "Sounds of Nature".

In 1963, I began a continuing relationship with the Canadian Broadcasting Corporation in the role of biological consultant, sound recordist and a script writer, chiefly in regard to "The Nature of Things" programs. I participated in CBC expeditions to the Galapagos Islands in 1965, United Kingdom in 1966, East Africa in 1967 and the Canadian Arctic in 1971, 1972 and 1975. I received the CBC's Wilderness Award in 1972 for contribution to the "Living Arctic", which is a one-hour special program.

Between 1964 and 1972, I started as representative of the Canadian Wildlife Service on the National Research Council's Associate Committee on bird Hazards to Aircraft. Part of this work involved intensive studies of bird migration -- particularly geese and whistling swans -- through the use of radar photography and radio telemetry.

From 1970 to the present time, I have formed with two partners an environmental research firm, L.G.L. Limited. L.G.L.'s research projects prior to their involvement with Williams Brothers in the Arctic Gas project included a preliminary survey for Imperial Oil Limited in the Mackenzie Delta relating to distribution of waterfowl, and their nesting and migration areas.

I have been responsible for the planning and general supervision of the ornithological studies from inception to the present time.

Q Dr. Gunn, you have to your credit, the publications that are listed in Appendix "A" to your resume. A 2 1/2 page list of publication. Mr. Commissioner, in the Appendix "A", that was included with the direct evidence as filed, one of the relevant publications was omitted. We've had it -- we've had the resume retyped. This item is enclosed -- is included -- within the revised Appendix "A" and I will just read it into the record in case some of them are missing it.

The report is entitled "Report on Wildlife Observations Arctic Weather Station, re Supply Missions, July 15 to September 7, 1949," Dominion Wildlife Service, Department of Mines and Resources, 1949.

Mr. Commissioner, I would like to file a copy of Dr. Gunn's resume as the next exhibit.

(DR. GUNN'S RESUME MARKED EXHIBIT 344)

Q As well, sir, I would like to file as exhibits, Exhibit "B" to the panel's evidence which sets out the Biological Report Series.

(BIOLOGICAL REPORT SERIES, MARKED 345)
(SUPPLEMENT AL 1975 MARKED EXHIBIT 346)

Q There is also a supplement to that list which sets out the 1975 reports. I would like to have that introduced as an exhibit, as well, sir. All of these documents I have stapled together and I will give the group to Miss Hutchinson.

The next is Exhibit "C", to the panel's evidence which sets out the current studies and research programs. The next is Exhibit "D" future studies and research programs. The next is Exhibit "E" to the panel's evidence, list of reports relied upon by the panel. Sir, all of these documents, Appendix "A" through "E" to the panel's evidence are described in Mr. Hemstock's evidence. Finally, sir, I would like to file as exhibits, a set of the Biological Report Series. I spoke to Miss Hutchinson about an appropriate way to have them numbered. The

Hemstock, Dabbs, McCart, Gunn
Jakimchuk, Banfield
In Chief

set is not yet finalized in as much as work is still going on and there will be additional volumes will be added to the set as the studies are completed and the reports are prepared.

At the moment, there are some 37 volumes and in addition there is a map folio that accompanies the volumes. We thought it might be best to give one exhibit number to the set with an identifying letter or number in parentheses after it so that additions could be made to the set as new volumes are available.

(DOCUMENTS C THROUGH E MARKED EXHIBITS 347,348,349)
(34 VOLUMES BIOLOGICAL REPORT SERIES EXHIBIT 350)

THE COMMISSIONER: Fine.

MR. GOUDGE: Mr. Marshall, I suppose you will be supplying us with copies of the additional volumes as they are published.

MR. MARSHALL: I had understood that they were being sent out. If the participants haven't received their copies of the most recent volumes, we do have some in our office upstairs to be made available to you. But if you do have them, if they have been sent out in the ordinary mailing to your office, we would appreciate your not getting too many extra copies, Mr. Goudge, as we only have five or six extra ones here at the moment.

All of the participants, I believe, are on the mailing list for the reports as they come out. If that's not so, well, we'll see that they are made available to the participants in the

Inquiry.

That completes the preliminary matters and I would now ask Mr. Hemstock to begin the evidence of the panel.

WITNESS HEMSTOCK: A Thank you, sir. I will begin with a brief review of the work undertaken by Canadian Arctic Gas with respect to the living environment.

The project was first considered by Northwest Project Study Group and then later Gas Arctic Systems began a study as well.

The Northwest Project undertook their environmental studies through the route of using recognized and highly qualified consultants. The work on vegetation was carried out by Northern Engineering Services Company Limited and R.M. Hardy & Associates under the direction of Mr. Donald Dabbs. The surveys on fisheries were carried out by Dr. Peter McCart of the University of Calgary and latterly as president of his own company, Aquatic Environments Limited. Ornithological surveys were conducted by LGL Limited under the direction of Dr. William Gunn, President. The study of mammals was done by Renewable Resources Consulting Services Limited under the immediate supervision of Mr. Ron Jakimchuk, President. Archaeological reports were prepared under the overall direction of Dr. J.V.M. Millar of the University of Saskatchewan. Aesthetic considerations were discussed by Mr. S. Moorehead of Synergy West Ltd. Dr. Frank Banfield provided advice on several aspects of the research

programs and kept in overall close touch with the work in the field.

The approach of the Gas Arctic Group was to leave the direction and study of the environment to an independent group known as the Environmental Protection Board. This Board is made up of eight scientists or engineers highly regarded in their respective disciplines. It was part of the policy of this group that all their studies should be made public as soon as possible and the policy has been continued after the merger with the Northwest Project Study Group and of course the monetary support of the Board has continued under Canadian Arctic Gas.

The Environmental Protection Board has published three interim reports in 1971, 1972, and 1973, and in September, 1974, issued its Environmental Impact Assessment in four volumes. The Board has presented evidence to this Hearing.

When the two groups joined in June, 1972, the various environmental studies were coordinated by those responsible in Arctic Gas. It was found that there had been remarkably little duplication and overlap, primarily due to cooperation in the field prior to merger, and the various projects were continued to completion in 1972.

In 1973 a single research program was outlined on the advice of the consultants from various disciplines and the Environmental

Protection Board. This work was carried out by Renewable Resources, LGL, Northern Engineering Services and Aquatic Environments. The scope of all these studies is probably best illustrated by a list of the reports available as supporting documents to the application,in general referred to as the Biological Report Series. A list of the Biological Report Series is attached as Appendix "B".

MR. MARSHALL: Those are now Exhibit 350 in the Inquiry.

The objectives of these studies were to provide the baseline information, and to investigate impacts of disturbance on wildlife so that the environmental impact of the project could be minimized. Consultation and advice to engineers and executives was provided from the start regarding the location, design, construction and operation of the pipeline.

The research program is continuing and the various current studies are outlined in Appendix "C". Assuming that the project goes ahead, Arctic Gas has plans for a number of programs for the future and these are listed in Appendix "D". Appendix "E" covers those reports relied upon by the panel members.

The environmental research program has extended from Prudhoe Bay to the two delivery points on the 49th Parallel including both the interior and coastal routes in Northern Alaska and Yukon. After extensive study, the coastal route has been selected as the prime route.

We believe that the studies are adequate to provide the basis for rational decisions regarding granting of a permit for the pipeline and furthermore, that the studies have provided the information necessary for compliance with the Northern Pipeline Guidelines of the Department of Indian Affairs & Northern Development and the regulations of the National Energy Board. The baseline studies have a time base of 5 years now, and this will be extended in key areas in the future. This has provided an excellent measure of the natural variations with time. Mitigation studies have been providing satisfactory results and these studies will be continued as detail design proceeds on a site specific basis.

The environmental program cost $12,894,000 to the end of 1974, and expenditures this year are projected to $3,023,000. There were four major reasons for such an extensive research program. They were:

1. To build an environmentally safe line that will perform throughout its life with a minimum impact and minimum maintenance.

2. To avoid work stoppages or delays during construction and to safely maximize field working time.

3. To establish the baseline data and the technology to ensure additions and modifications can be built with minimum cost and minimum delay and yet with the assurance of environmental safeguards. Any other new Arctic pipelines will also benefit from the basic work.

4. To meet the requirements of various government Acts and stipulations.

The monitoring of the pipeline from an engineering or operating standpoint will also provide the facility for the monitoring of the environmental impact along the route and in many instances, will provide additional information on the wildlife in the area. It will also provide input on some of the more destructive natural phenomena such as forest fires. The environmental studies done to date are a major contribution to the scientific community. The material has been made available to the government, the academic and scientific community and the public. In addition to being of scientific interest, this information will provide important data to the evaluation of other northern developments.

The co-ordination between environm ental and engineering people has been one of the most important functions of the environmental staff of Canadian Arctic Gas, It is obvious that the questions with regard to the feasibility and the best construction and operation technology for the pipeline can be answered only after consideration by the various disciplines involved. Both the environmen tal and the engineering staff in Northern Engineering have been

housed in the same building and there has been day to day contact between environmental and engineering people. It has been the responsibility of the Canadian Arctic Gas staff to ensure that in addition to this, there was more formalized consultation between the various environmental disciplines and also with the engineering people. Co-ordination has also been accomplished by arranging formal meetings and also by direct contact between ourselves and the two departments.

The organization of the environmental department in Arctic Gas includes Dr. Randall Gossen, as co-ordinator of environmental research, and Mr. Doug Rowe, as co-ordinator of the engineering and environmental interface. Mr. Ray Glasrud is environmental manager for Northern Engineering and he and his staff co-ordinate the field work of the various consultants. Mr. Glasrud reports to Dr. Jack Clark, who also heads up the Geotechnical Section in Northern Engineering. Northern Engineering employs Aquatic Environments, L.G.L., Renewable Resources and Dr. Frank Banfield to conduct the required studies for Arctic Gas.

In addition, an Advisory Committee of environmental officers from the various sponsor companies meets on a regular basis to provide advice to me and to my staff in environmental matters.

An interdisciplinary meeting was held during the week of April 9, 1973, and during this meeting virtually every mile of the pipeline was assessed under the joint criticism of engineering and environmental people. Those attending included

mechanical, construction and soil mechanic engineers, geologists, hydrologists, socio-economists, and representatives of the various disciplines on the environmental side. The procedure used was to consider the alignment sheets or photomosaics on a sheet by sheet basis, to determine what the environmental concerns were, what the engineering concerns were, where any conflicts might arise, and further to decide if additional work might be required. This sort of meeting was followed by a similar one in May and again as illustrated in the application (Section 8al), the result was a change in align ment as has been discussed by Dr. Clark before this hearing.

Q Thank you, Mr. Hemstock. Mr. Dabbs, would you please deal with the matters related to vegetation?

WITNESS DABBS: The purpose of my testimony is to outline the objectives and to describe the vegetation studies conducted for Canadian Arctic Gas, which included vegetation surveys, revegetation experimental projects and monitoring studies; and based on the research findings, to state my opinion that the pipeline right-of-way can be successfully revegetated.

Objectives of the vegetation program and studies included the collection of baseline data on natural plant communities and soils in order that an assessment of the probable impact of the construction and operation of the chilled gas pipeline in the northern Yukon and the Mackenzie Valley could be ascertained. A second and equally important objective was the develop-

ment of a program for the revegetation of all land surfaces disturbed by pipeline construction and related activities. The rationale behind this program is the restoration of a stabilizing plant cover for the purposes of erosion control, both for the purpose of protection of environmental quality and the protection of the pipeline itself.

To achieve the project goals, the study programs were established along three major lines of research. The first such area of research was the vegetation survey and classification.

To gain an understanding of the structure and to a degree the function of botanical components of the ecosystems traversed by the proposed pipeline, field investigations were undertaken which have produced the classification of the terrain and the associated plant communities. By reducing the complex landscape to a manageable number of ecologically meaningful units, the influence of various environmental factors on plant growth and productivity can be better understood. With this type of understanding, an impact assessment is possible once the details of construction and maintenance activities are known. Secondly, an understanding of soil, climate and native vegetation provides the information basis on which to make decisions on restoration or revegetation actions to be taken at any location along the pipeline route.

The second major area of research has been revegetation trials which have been established at the test facilities at Norman Wells, Sans Sault, and

Prudhoe Bay, and other locations such as Inuvik and Tuktoyaktuk. This research program has evaluated the performance and the usefulness of a wide range of available grass and legume species for the purposes of land surface revegetation in northern areas. The program started in 1971 and is a continuing activity, re-examining both the established plots which have been under study for the last several years and the addition of new plots in new areas.

Additional research programs have been established to evaluate species performance in different habitats on new varieties that have since come to light and are considered potential candidates for revegetation. This work will continue up to and including the time of construction, as it is important to understand not only the short-term, but the long-term performance of all candidate varieties. It is also important to understand the rate and character of change which takes place as native species colonize and eventually dominate disturbed, reseeded areas.

A third area of research which has been under way for the past three years has been one of environmental monitoring. The objective of this program was to establish the natural conditions of drainage, soil and vegetation in a representative study area in the Mackenzie Valley prior to the construction of either a highway or a pipeline. The objective will be to return to the same site during the time of construction and for a period of time following construction in order to measure and confirm environmental

impact predictions, and recommend mitigative actions and provide a data base for future environmental impact assessments.

Vegetation survey programs were initiated in 1972 with studies in the Northern Yukon, including both the prime and interior routes, and the mid-Mackenzie Valley. In 1973 the program was extended to north-eastern Alaska and all of the southern Mackenzie Valley down to the 60th Parallel. In 1974 the program was extended to include a case history study of existing pipelines in Western Alberta, through the Crowsnest Pass into British Columbia, and across South-western Saskatchewan. In 1975 the survey program included the cross-delta route, plus the new routing in the Fort Simpson area.

The specific objectives of these research programs were:

1. To describe the major community types and establish a framework of vegetation patterns and relationships.

2. To characterize the terrain types according to present plant cover and associated soil properties which can be important in revegetation programs.

3. To indicate some of the problem areas on the pipeline route and make recommendations regarding terrain stability based on the vegetation study.

4. To provide information for right-of-way clearing and cost calculations based on shrub and tree cover.

5. To determine the growth characteristics of plant communities in order to predict the response of these

natural and man-induced disturbances.

6. To provide zoologists with a vegetation classification for purposes of identifying animal habitats.

To date, four volumes of the Biological Report series have contained the results of these survey programs. These include Volume I, Vegetation of the Northern Yukon Territory; Volume III, Part I and Part II, Vegetation and Soils of the Mackenzie Valley; and Volume XXI, Vegetation and Soils of Northeastern Alaska. Research in the areas I have mentioned is continuing and the results will be published as they are available.

As manager, I was responsible for the programs and the establishment of the major objectives. I spent time in the field with each of the senior research personnel to ensure that I was satisfied with the manner in which they were conducting the studies and to familiarize myself with the area and terrain in which they were working. The responsibilities for the scientific approach, analysis and writing of the report rested with the senior authors of each report.

For all of our vegetation survey studies, terrain analysis had already been done by Dr. Mollard and was plotted on photomosaic strips which are referred to as alignment sheets. These were extremely important to our studies, as they provided the means of relating vegetation types to terrain units, thus providing the basis for extrapolation from study areas to the entire pipeline route. Sampling,

however, went beyond the narrow confines of the right-of-way on the photomosaics because of course for a proper ecological study it was necessary to put the project into a landscape perspective.

I wish to point out that there is a very close relationship between plant ecology and geotechnical engineering at the level of terrain analysis. The classification and mapping of landforms is fundamental to both sciences. Consequently, there has always been a very close tie between the two groups working on this project.

Getting into revegetation studies, this topic was dealt with during Panel 1 of Phase 2 of the Inquiry, and the results of revegetation studies and current proposed revegetation specifications have been presented by Younkin in his report which was attached as Appendix "C" to the Phase 2 testimony.

The primary objective of the revegetation program is to provide an initial erosion control cover which, when combined with the physical drainage and erosion control techniques, provide the stabilization of all disturbed areas along the right-of-way and associated facilities. A second and equally important objective is to aid natural plant succession processes in the re-establishment of a permanent stable natural plant cover.

The research conducted at the test facilities at Prudhoe Bay, Sans Sault, Norman Wells, plus numerous additional test areas in the Inuvik, Tuktoyaktuk and delta regions, have led us to conclude

that revegetation of the pipeline and associated facilities is feasible. It may be necessary in many areas, particularly in tundra regions, to supplement the seeding and fertilization of the right-of-way with other techniques such as planting of shrub cuttings, use of erosion control mats, and the stripping and replacement of tundra cover to achieve the degree of revegetation required. Maintenance, by way of additional seeding and perhaps additional fertilization, may be required for several years following construction. It is anticipated, however, that this will be limited to relatively small sections.

The impact of pipeline construction on plant communities would be the removal of plant cover over the ditch line, leaving the backfill crown devoid of a plant cover. This will be mitigated by a revegetation program which will assist in placing the disturbed pipeline crown into an early successional stage. From this stage, natural succession processes will take over and in time (depending on location and right-of-way maintenance) the native plant communities will re-establish themselves on these disturbed sites.

To achieve our goal of aiding the disturbed system to return to a stable, natural condition, we have undertaken to collect and multiply the seed of several native pioneering grasses in order that we might use this seed in our revegetation program.

The project was started in 1973 under the direction

of Dr. Younkin. Seed of Bluejoint (Calamagrostis canadensis) and Polar Grass (Arctagrostis latifolia) were hand collected from several locations between Fort Simpson and Tuktoyaktuk.

Research on this project has carried on through 1974 and 1975, both in the greenhouse and in field trials. The greenhouse research has been aimed at answering basic biological questions such as day length required for floral initiation and seed set, nutrient requirements, competitive ability, etc. Field trials for the production of seed have been established in Northern Alberta and at a site within the Mackenzie Delta proper.

As the selection and multiplication of any plant species for use on a commercial or semi-commercial basis is a long and complex program, the results to date have been encouraging, though very little solid data exists to prove that it will in fact be feasible to produce these native species for pipeline revegetation. The program is continuing into 1976, thus providing an additional growing season which will assist greatly in determining the feasibility of the program.

Research conducted by Hernandez (1973) and the applicant, has shown that the use of agronomic varieties of grasses does not constitute a threat to native plant communities in the sense of introducing exotic species.

By definition, an exotic species is considered one which has come from an

entirely different part of the world than that to which it is being introduced, its potential for migration and establishment in its new habitat being unknown. The danger posed by an exotic species is that it may have a unique genetic potential which would enable it to displace native species from their natural communities. The danger is especially great if there are no close relatives of the new species in the area of introduction.

Although a number of species proposed for inclusion in the reseeding program are technically imports from Europe, all were introduced into North America 50 to 200 years ago, and all belong to genera which are a natural part of northern ecosystems. Creeping red fescue, Reed canary grass, and slender wheatgrass are species native to boreal regions of Canada. The commercial varieties are genetic strains which have been selected from existing native populations. Kentucky bluegrass, meadow foxtail, and timothy are typical species of cool temperate regions which were introduced into the Arctic by human activity as early as the 1940's. Nugget Kentucky bluegrass, for example, is a selection from a hardy strain of poa pratensis believed to have been introduced into Alaska during the gold rush. Most are now circumboreal or circumpolar in distribution, but restricted to disturbed habitats. Red top is never found in Arctic regions, but is common in Western Canada and has had sufficient time to migrate into Arctic areas if the environment had been suitable.

Of the major factors involved in successful plant migration, none is more important than the suitability of the environment. It is a tenet of plant geography that most plant migrations within a continent occur rapidly so that favorable environments for any given species are soon completely occupied. Resultant communities, established by the combination of many such separate plant migrations, then close to new inhabitants unless the environment changes or a species of greatly different genetic capability is introduced into the area. If the environment is suitable and extensive, the migration of the introduced species is usually rapid, as is the case of prickly-pear in Australia, which spread over thousands of acres of sheep range land in a matter of years. However, in the case of hundreds of species introduced into North America since colonial times, few have been able to displace native species from undisturbed natural communities. Almost without exception, their success was and remains in those communities disturbed in some way by man.

Present day construction and exploration activities in the Arctic have lead to the introduction of many species to disturbed airports and roadside sites. Few are known to have invaded undisturbed plant communities. Studies by Hernandez (1973) in the Mackenzie Valley have shown that when seed of the proposed seed mix species have been broadcast onto the native tundra, few are able to reach even the seedling stage and appear to rapidly die out over a two-year period.

I therefore conclude that there will be no harmful impact on the plant communities bordering the right-of-way from the use of the commercially available -- commercial varieties of grasses proposed for re-vegetation.

Another impact of re-vegetation may be disturbance of wildlife due to seeding activities. Winter seeding (as proposed by Younkin) will reduce to a great extent the need for aircraft, either fixed-wing or helicopter for seeding -- for spring seeding which is a critical time of the year for waterfowl and mammals, particularly caribou. Helicopter seeding of areas on the North Slope would not commence before June 20 which places it a week or more after the last known date of calving of the Porcupine Caribou herd, thus eliminating any direct conflict between aircraft activity and cows at the time of calving.

We have been involved with the assessment of other aspects of the project on

vegetation. This has included the snow road trial conducted in the winter of 1973-74 at Inuvik. The test site was examined in the fall, permafrost probes and transects established, and the depth of organic cover measured for the purpose of evaluating the changes which might take place caused by the construction and operation of the snow road. The snow road test site was examined during construction and re-examined in the spring as the snow melted and runoff was taking place. The same transects were re-probed and the depth of organic matter re-measured in the fall of 1974. The report on this evaluation is contained within the Inuvik Snow Road Report prepared by Northern Engineering Services. The major conclusions of that evaluation were:

1. There was a large decrease in the percent of ground cover, especially by evergreen and deciduous shrubs, due to the construction and the use of the snow road.

2. The decrease in percent ground cover of these shrubs does not appear to be permanent, and the plants should recover to their former condition within a relatively short time.

3. There was no significant change in surface elevation, organic layer thickness or active layer thickness.

We conclude, therefore, that a processed snow road constructed in a manner similar to the test road in Inuvik will protect the insulative organic cover and most of the ground level living

plants so that recovery will be quick with no significant alteration in active layer depths. Further south in the Mackenzie Valley there will be a slow degradation of permafrost to a new equilibrium level with a deeper active layer due to the removal of trees on the right-of-way. Maintaining the ground organic cover will prevent erosion and any serious environmental impact.

The results of our investigations following the second growing season confirm our predictions regarding the recovery of the shrubs on the road. We found also that there was no change in depth of thaw in the active layer across the road at several locations.

Plans currently call for the use of methanol as a freeze depressant for hydrostatic testing of the pipeline. The Applicant has designed research programs to determine the effects of a spill on plants and the persistence of methanol in soils in the event of a pipeline failure during testing or spill during transportation or storage. In the event of such an occurrence, the methanol would eventually disappear by a combination of the processes involving volatization, sublimation, and biodegradation.

Various species of soil bacteria are capable of utilizing methanol as a carbon source, for example, Pseudomonas, Achromobacter, Flavobacterium, Mycobacterium, and Xanthomonas. These species are commonly found in Arctic soils.

Studies are presently underway both in the laboratory and at experimental

test site in the north to define more precisely the mechanisms of methanol disappearance and to determine the effect of methanol on soil bacteria and fungi.

Studies have also been, excuse me, carried out at a test site near Inuvik to determine the effects of winter spill methanol on vegetation. The first report on this research was presented by Younkin in March of 1975 entitled "The Effects of Winter Methanol Spills on Forest-Tundra Vegetation." The conclusions drawn at that time were:

1. Winter methanol spill rates of greater than 9 litres/m^2 have a damaging effect on vegetation, leading to reduction in plant cover of up to 65%.

2. The deleterious effects of a winter methanol spill on vegetation appear to be primarily on above-ground parts. Regrowth of new leaves and shoots was apparent on some species the summer following the spill.

3. In the summer following the methanol application the reduction in plant cover had not resulted in a significant change in active layer thickness.

This research is continuing and further results will be presented when they are available.

The research to date has demonstrated the feasibility of re-vegetating the pipeline. However, this alone would not be adequate to demonstrate that Arctic Gas is prepared to undertake

the best possible re-vegetation program. Many of the various -- varieties, I'm sorry -- found to grow successfully in northern areas are not grown commercially in large quantities. Consequently, Arctic Gas engaged the services of a seed broker to assist us in writing seed multiplication contracts with certified growers. This action was deemed necessary due to the very long lead time required to build a seed supply.

To ensure the supply of specialized varieties, Arctic Gas has contracted for the growing of five different varieties with a total contract value in excess of one-half million dollars. These contracts are currently being revised to correspond with revised seed specifications and delayed construction schedule.

The re-vegetation research has demonstrated the value of two unlicensed varieties, Arctared Creeping Red Fescue and Engmo Timothy, for use in northern regions. Based on the research presented to the Department, Agriculture Canada issued the release of these varieties specifically for Arctic re-vegetation on December 16, 1974.

It is my conclusion that we will be able to successfully re-vegetate the pipeline right-of-way (either prime or interior route- and associated facilities as required by the DINA Northern Pipeline guidelines and the N.E.B. pipeline regulations. Of course, it is impossible to predict climatic variations. In any one particular season, we

anticipate that we may encounter problems in achieving successful re-vegetation in some areas. We will therefore have a surveillance program, in order to identify these areas at a very early stage, and take action to solve any erosion or potential erosion problems.

MR. MARSHALL: Thank you, Mr. Dabbs.

THE COMMISSIONER: Maybe we could stop for five minutes and stretch our legs.

MR. MARSHALL: Certainly, sir.

(PROCEEDINGS ADJOURNED FOR EVENING RECESS)

(PROCEEDINGS RESUMED PURSUANT TO ADJOURNMENT)

MR. MARSHALL: We have just completed Mr. Dabbs evidence pertaining to vegetation and the next section of the panels evidence is that pertaining the aquatic environment and I would ask Dr. McCart to deal with that sir.

WITNESS McCART: The purpose of my testimony is to comment on the programs and studies conducted by Aquatic Environments Limited and to comment on the likely impact on aquatic environments from the construction and operation of the proposed gas pipeline and to discuss these in light of the information which has resulted from CAGSL-sponsored studies.

Mr. Hemstock will be presenting evidence regarding mitigate measures later in this panel.

I would like to amplify some of the points raised by Mr. Hemstock concerning the impact of the pipeline on aquatic environments and fish populations in particular. In doing so, I will follow the sequence in which they will be discussed by Mr. Hemstock.

First, critical areas. The applicant has expended great effort, both in Canada and in Alaska, in identifying areas potentially critical to populations of fish. These include, spawning, rearing and overwintering areas. Information concerning such areas has been made available to this Inquiry and to

the public in a variety of ways:

1) In Chapter III of Volume 15 of the Arctic Gas Biological Report Series, "Fall spawning and over-wintering areas of fish populations along routes of proposed pipeline between Prudhoe Bay and the Mackenzie Delta".

2) In Volumes 16, "Canada North of 60°N", 19, "Alaska", and 33, "Canada South of 60°N", of the Arctic Gas Biological Report Series. These are catalogues of lakes and streams found within various pipeline corridors which include an assessment of the importance of each stream to fish populations and the location of any known critical areas which might possibly be affected by pipeline development. The catalogues have been produced in a loose-leaf format so that any new information, from our own or other studies, can be inserted as it becomes available.

3) The Alignment Sheets which accompany the Application and which include comments on any known critical areas located within the area encompassed by the sheets.

I would emphasize that we do not pretend to have identified every potentially critical area within the compass of pipeline related effects. We do, however, feel that we have identified most of the major ones in Canada North of 60°N, and in Alaska. We will continue to add to our list as new information becomes available up to and including the construction phase.

Siltation. Siltation has been properly identified as a major concern for environmentalists interested in aquatic habitats. The applicant shares this concern and has carried out a number of studies of sedimentation at various locations along the pipeline route. These include:

1) Volume 15, Chapter III of the Biological Report Series which describes the effect of long-term sedimentation from a seismic trail on the invertebrate fauna of a small stream near Norman Wells.
2) A study, still in progress, of the effects of gas pipeline crossings on the invertebrate fauna and physical conditions in several streams in south-eastern British Columbia.
3) Innumerable observations, scattered throughout the applicant's reports, on natural sediment loads in lakes and streams, most notably Craig, P. and P. McCart, 1975. Arctic and Alpine Reserach, Volume 7(2), pages 183-189, excuse me, 183-198.

Our assessment, based on these studies and a survey of the relevant literature, is that the short-term sedimentation which is likely to occur as the result of pipeline-related activities, will have little effect on populations of acquatic organisms unless it occurs in the vicinity of an area critical to a population, most notably, if it affects the incubating eggs of fall-spawning fishes. Of the latter, the most vulnerable is the anadromous Arctic char which, in the Western Arctic, spawns and overwinters in restricted localities in small to moderately-sized streams.

This is the reason for the applicant's emphasis on studies of this species. Arctic fish populations are resilient, however, and evne Arctic char populations are unlikely to suffer permanent damage, as long as sedimentation is short-term. Natural hydrological processes will scour the streambed and, by the next year, conditions should be as they were prior to construction.

Long-term sedimentation, extending over several years, could have a much greater adverse effect on populations of aquatic organisms. However, serious long-term sedimentation is an unlikely consequence of gas pipeline construction. It would affect the structural integrity of the line as well as have environmental consequences and the applicant, both in its construction techniques and its contingency plans, has taken steps to ensure that long-term erosion does not occur.

<u>Oxygen Levels</u>. Because of the long period of ice cover, oxygen concentrations in northern lakes and streams can fall to very low levels during the winter. This is particularly true in shallow lakes and isolated pools in streams. Some reports seem to indicate that low levels are the rule in northern waterbodies. However, while northern water bodies certainly are vulnerable to artificially induced oxygen depression, the winter base-level oxygen concentrations in water-bodies may be higher than is generally supposed. Our studies indicate that, in the deeper lakes and where

water is running, oxygen levels frequently remain relatively high even under cover of ice, Biological Report Series, Volumes 16, 19 and 33. If stringent measures are taken to prevent the introduction into natural waters of materials such as domestic sewage, organic chemicals, etc., with a high biochemical oxygen demand, (B.O.D.), it is unlikely that oxygen depression resulting from pipeline realted activities will be a significant factor affecting populations of aquatic organisms.

Water Sources. Large quantities of water will be required, especially early in the winter, for the construction of winter roads and for pipeline testing.

Over much of its length in Canada North of 60°N, the pipeline parallels the Mackenzie River where water is available in large quantities throughout the year. Along the Beaufort Sea coast, however, in both Canada and Alaska, water availability is very much reduced during the winter. The applicant has undertaken a program to assess potential water sources along the North Slope in the Yukon Territory and Alaska. The study includes assessments of first, the quantities of water available at various times of the year and second, the potential environmental impact of water removal, particularly impact on fish populations and I should add that most of this material has been presented in the preceding panel and I don't propose at this point to run over an additional

progress report on this study, but I would be happy to answer questions during cross-examination.

Obstruction To Fish Passage.

There are two situations in which serious obstructions to fish passage could arise as a result of pipeline-related activity. These are first, at culverts and second, where berms are used at major river crossings.

Construction in Canada North of 60°N will require only a few short stretches of permanent road. As a result, only five culverts will be required at stream crossings, all of them south of Travaillant Lake. Of the five streams, it is likely that only three are utilized by fish. The applicant is very much aware of the problem of culverts and fish passage and has indicated, in response to question 41 of the Pipeline Assessment Group, that if culverts are used, the final design will be such as to ensure the safe upstream passage of fish.

Berm construction is planned for the Mackenzie River at Swimming Point and for the Great Bear River, response to question 44, Pipeline Assessment Group. The former will result in only slight increases in water velocity and is unlikely to act as an impediment to migration. At the Great Bear River, however, increases in average velocity of 18% to 22% can be expected. The fisheries consultants have indicated their concern and have been advised that various methods, including culverting through the berm, modifications to the configuration of the end of the

berm, can be used to keep velocities within acceptable limits. Also, in the unbermed segment of the stream, the natural substrate will be retained providing fish with natural resting places behind rocks, along banks, etc.

Interruption of Sub-Surface Drainage. Interruption to sub-surface drainage could have a detrimental effect on fish populations if it were to affect the supply of water to spawning or overwintering areas downstream of pipeline crossings. We have been informed that this is most likely to occur where there is no free flow of water above the substrate. The sub-surface water is forced to the surface prematurely, forming icings and depriving downstream areas of their water supply.

We have examined our records to identify locations where such a situation might occur. We can find no instance in Canada North of 60^{O}N, where a major segment of a population might be affected in this way. There are, however, several areas where small numbers of overwintering fish could be influenced. These include a spring between the Firth and Malcolm Rivers, where the pipeline passes approximately two kilometers upslope of a major spring which harbours overwintering juvenile Arctic char. Though the pipeline does not cross a stream, it could possible bisect the acquifer supplying the spring if the acquifer lies close to the surface. This could only be established by a drilling program and I have discussed this with Dr. Harlan.

MR. MARSHALL: That's the same program that you were discussing at some length with the various counsel last week?

WITNESS McCART: Yes, we discussed this for a considerable length.

The other possibilities are streams south of Norman Wells and include Canyon Creek, Prohibition Creek and the Ochre River. In each case, the pipeline crossing is dry or nearly so during the winter and there may be small numbers of grayling and other species overwintering downstream of the pipeline crossing.

I would like to emphasize that we are certainly aware of this problem but it seems that overall, it will not have a significant impact on fish populations. The circumstances in which the problem is likely to arise appear to be comparatively rare. If they are identified as the result of detailed on-site inspection during the final design phase precautions, including changes in crossing site and or the provision of buried, insulated conduits, can be used to mitigate disturbance to fish populations.

Borrow sites. The applicant intends to remove materials from river deposits (e.g. flood plains and terraces) wherever other sources are insufficient. To ensure that such removal does not disrupt stream habitats and populations of aquatic organisms, the applicant has defined a series of procedures for removing gravel from flood plains which ensure that any disturbance will be minimal. These procedures are presented in Appendix "A", Canadian Arctic Gas Pipelines Limited responses to Pipeline Application Assessment Group requests for supplementary information, October, 1974. Chief among them from the aquatic viewpoint are that:

1. Each site will be examined to assess the potential impact of gravel removal on populations of aquatic organisms.
2. The final boundaries of the borrow area will be designated in part on the basis of on-site inspection by an aquatic biologist;
3. Every effort will be made to reduce sedimentation including provisions that:
    (a) working areas in the active flood plain will be separated by berms, dikes, etc., so that no materials will be removed from flowing water;
    (b) the passage of construction equipment through flowing water will be restricted;
    (c) an appropriate buffer zone will be maintained between streams and gravel removal areas on fossil flood plains.

The applicant is continuing to assess methods of gravel removal in flood plains. In September, 1974, the applicant's consultants conducted a reconnaissance of borrow sites along the Alyeska Pipeline right-of-way from Dietrich Camp to Prudhoe Bay. A report of this survey, which includes recommendations for procedures to reduced environmental impact, has been made available to this Inquiry.

Interior route versus the prime route. From the aquatic viewpoint, the prime route --

THE COMMISSIONER: Excuse me, Dr. McCart. Just so there 's no misunderstanding, I take it that the prime route which you propose to discuss here is the route that skirts the Mackenzie Delta and is not the route across the mouth of the Mackenzie Delta?

A That's correct. That's the prime route --

Q The old prime route.

A -- prior to the cross-delta alternative.

MR. MARSHALL: Yes sir, there has not yet been an amendment filed, although I think there will be one

THE COMMISSIONER: Fine, I understand, I just want to make sure we all know what Dr. McCart is talking about.

A From the aquatic viewpoint the prime route is preferable to the interior

route. This preference is the result of conditions on the Alaskan portion of this route. In Alaska, the interior route follows the valley of the Marsh Fork of the Canning River. This is a narrow, steep valley with a considerable winter flow which is utilized by a large population of anadronmous (sea-going) Arctic char. There are a number of objections to this routing:

1. Because of the narrowness of the valley there is little latitude for route adjustment and the pipeline must pass close to a number of important spawning and over-wintering areas (see Craig & McCart, 1974 , Fall Spawning & Overwintering Areas...Arctic Gas Biological Report series, Volume 15, Chapter III).

2. The routing requires the construction of a permanent road, thereby increasing the requirement for borrow materials and the level of construction activity. In addition, roads are generally considered to have a greater potential for sediment production, particularly over the long-term, than are buried pipelines.

3. Pipeline construction would take place during the summer and early fall period. From approximately mid-August construction would conflict with the activities of spawning and overwintering Arctic char.

Fort Simpson Realignment.

As a fisheries consultant, I am in favor of the new alignment in the vicinity of Fort Simpson. The major reason for this is that the new routing eliminates one major river crossing (the Liard River), in the vicinity of a possible overwintering area for fish without endangering any areas thought to be critical to

populations of aquatic organisms.

Effects of methanol on fish. The applicant has carried out studies of the toxicity of methanol to the eggs and juveniles of Arctic char and grayling (McMahon & Cartier, 1974, Methanol Toxicity and effects of methanol on development in Arctic char and grayling, interim report, Arctic Gas Biological Report series, Volume 15, Chapter V). The results, similar for the two species indicate that juveniles can tolerate concentrations as high as 1% methanol for a one-week period without any apparent effects. Of over 200 fish exposed to 1% methanol for periods of up to 168 hours, only one died.

To determine the toxicity of methanol to developing eggs, both grayling and Arctic char eggs were exposed to methanol for periods of several months, from their arrival at the laboratory until hatching. Some effects of this long-term exposure retarded development and premature hatching, were apparent at concentrations as low as 0.01% methanol.

It is apparent that methanol could cause mortality to fish if a large volume of a concentrated solution were to flush through an area in which fish or their eggs were confined. Further, even a relatively low concentration could cause mortality to eggs if the methanol were present over a long enough period.

The applicant expects that few, if any, ruptures will occur. Thus the probability that a sizeable leak will occur is small and the

probability that such a leak will occur in the vicinity of an area critical to populations of fish is even smaller. Nevertheless, the applicant is developing contingency plans to control flows of the test fluid, should ruptures occur. We would recommend that during tests, special attention be given to any critical areas which occur within the test section, and that cleanup equipment be stored nearby so that immediate action can be taken in the event of a spill.

Finally, overall impact. Dr. N.J. Wilimovsky of the Environmental Protection Board has preceded me as a witness before this Inquiry. In summarizing his testimony, he concluded that:

> "The overall effect of the construction and operation of the gas pipeline on fishes and other aquatic organisms would likely be minor."

He also indicated that with specific reference to fish, an oil pipeline would be 3 to 5 times and a road 6 to 10 times more dangerous than a gas pipeline. I would concur with his overall assessment, emphasizing however that there is still the danger of serious disturbance to individual, local populations. In the past, we have expended much effort in studies of representative habitats and local populations and in future we intend to carry out detailed on-site studies in the vicinity of major facilities, as part of the final design phase. This will permit us to define precise mitigative measures in those areas where disturbance is likely to be

greatest. I am satisfied that our aquatic studies have met the requirements of the applicable N.E.B. regulations and that insofar as my discipline is concerned, the pipeline can be built within the requirements of the DINA Northern Pipeline Guidelines.

MR.MARSHALL:
Thank you, Dr. McCart.
Mr. Commissioner, I expect it would take an hour to deal with the next section of the panel's evidence. Do you wish to adjourn?

THE COMMISSIONER: I think we will adjourn.

Q Dr. McCart, I remember that evidence of Dr. Wilimovsky's and the extended guidelines for northern pipelines require that we consider not only the impact of the gas pipeline, that Arctic Gas and Foothills proposes to build, but the impact of an oil pipeline as well. Dr. Wilimovsky mentioned a highway; the highway proposal has been curtailed, as we all know, and they now say they intend only to take it as far as Wrigley, and that segment won't be completed until 1979.

So that the situation as regards a highway doesn't appear to have changed. There has been some clearing along the Mackenzie River north of Norman Wells. I think that is as far as the clearing has gotten. The actual construction extends north of Fort Simpson, I think, to the vicinity of River Between Two Mountains, and will carry on the very limited distance from there to Wrigley between now and 1979. So at the moment the gas pipeline, which Arctic Gas

and Foothills propose to build is a component of this proposed energy and transportation corridor that has to be considered.

The oil pipeline, the Beaufort-Delta group,have advised the Government of Canada they want to build an oil pipeline to bring crude oil from the Mackenzie Delta and the Beaufort Sea by 1983. So assuming that the gas pipeline were built, if the oil pipeline would follow, we would have two of these components in the Mackenzie Valley, and though no one has proposed as yet to build an oil pipeline across the North Slope to -- of Alaska and the Yukon, along the prime route of the gas pipe-line, that is something that might well have to be taken into consideration if the United States decided to open up petroleum reserve No. 4 on the north coast of Alaska. Then, of course, we have Mr. Horte's evidence that if the gas pipeline is built it is likely that it will be looped within five years of the commencement of construction, so that what concerns me, and you might think about this over-night and if you want to say anything about it tomorrow you certainly don't have to, What concerns me is that you have dealt in great detail with the impact of the proposed gas pipeline, you did in the last phase and you have done so again tonight.

The gas pipeline is one component of this corridor. A second gas pipeline which is what looping entails would be a second component of the corridor. And the oil pipeline would be a third component. The highway would be a fourth component except that it seems to have stalled somewhere south of Wrigley for the moment.

At any rate, you might give some consideration if you wish to the impact that all of these things might over a period of years in the Mackenzie Valley and on the North Slope because the pipeline guidelines make it plain that this gas pipeline must be considered in this context of a transportation corridor, an energy and transportation corridor and we cannot expect Arctic Gas and Foothills to carry out the same detailed examination in relation to proposed future developments as they have done in connection with the gas pipeline but the pipeline guidelines do require Arctic Gas to present evidence on those matters.

I have already told both pipeline companies that a number of times and they will be bringing that evidence forward but if you can give us your thoughts on that matter and this applies to all of your colleagues on the panel as we go along, I would appreciate it.

At any rate, I'm not trying to tell you, Mr. Marshall, or your -- or anybody else how to proceed but if you have any thoughts on those matters as we go along, I wish you would let me have

because that's what we're supposed to do, not just assume that if a gas pipeline is built, that is all that will ever happen. We're bound to look beyond that to developments that may come in its wake, And the President of Arctic Gas, Mr. Horte, has indicated that the second gas pipeline is one development that he feels likely will come within five years of the construction of the gas pipeline.

The Beaufort Delta Group, which includes the producers, Shell, Gulf, and Imperial proposes to build an oil pipe by 1983 and the Federal Government may crank up this highway again one of these days. So that's what we're looking at.

Well, we'll adjourn till 9:00 in the morning. 9:00 in the morning.

(PROCEEDINGS ADJOURNED TO NOVEMBER 18, 1975)

MACKENZIE VALLEY PIPELINE INQUIRY

IN THE MATTER OF APPLICATIONS BY EACH OF
(a) CANADIAN ARCTIC GAS PIPELINE LIMITED FOR A RIGHT-OF-WAY THAT MIGHT BE GRANTED ACROSS CROWN LANDS WITHIN THE YUKON TERRITORY AND THE NORTHWEST TERRITORIES, and
(b) FOOTHILLS PIPE LINES LTD. FOR A RIGHT-OF-WAY THAT MIGHT BE GRANTED ACROSS CROWN LANDS WITHIN THE NORTHWEST TERRITORIES,
FOR THE PURPOSE OF A PROPOSED MACKENZIE VALLEY PIPELINE

and

IN THE MATTER OF THE SOCIAL, ENVIRONMENTAL AND ECONOMIC IMPACT REGIONALLY OF THE CONSTRUCTION, OPERATION AND SUBSEQUENT ABANDONMENT OF THE ABOVE PROPOSED PIPELINE

(Before the Honourable Mr. Justice Berger, Commissioner)

Yellowknife, N.W.T.

November, 18, 1975.

PROCEEDINGS AT INQUIRY

Volume 89

ALLWEST REPORTING LTD.,
4299 CANADA WAY,
BURNABY 2, B.C.

APPEARANCES:

Mr. Ian G. Scott, Q.C., Mr. Stephen T. Goudge, Mr. Alick Ryder and Mr. Ian Roland	for Mackenzie Valley Pipeline Inquiry;
Mr. Pierre Genest, Q.C., Mr. Jack Marshall, and Mr. Darryl Carter	for Canadian Arctic Gas Pipeline Limited;
Mr. Reginald Gibbs, Q.C., Mr. Alan Hollingworth & Mr. John W. Lutes,	for Foothills Pipe Lines Ltd.;
Mr. Russell Anthony & Pro. Alastair Lucas	for Canadian Arctic Resources Committee;
Mr. Glen W. Bell and Mr. Gerry Sutton,	for Northwest Territories Indian Brotherhood, and Metis Association of the Northwest Territories;
Mr. John Bayly or Miss Leslie Lane	for Inuit Tapirisat of Canada, and The Committee for Original Peoples Entitlement;
Mr. Ron Veale and Mr. Allen Lueck	for The Council for the Yukon Indians;
Mr. Carson H. Templeton,	for Environment Protection Board;
Mr. David Reesor	for Northwest Territories Association of Municipalities;
Mr. Murray Sigler	for Northwest Territories Chamber of Commerce.

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WITNESSES FOR CANADIAN ARCTIC GAS PIPELINE LIMITED:

A.W. Frank BANFIELD
Donald L. DABBS
William W.H. GUNN
Russell A. HEMSTOCK
Peter J. McCART
Ronald D. JAKIMCHUK
- In Chief 13398
- Cross-Examination by Mr. Gibbs 13530

Yellowknife, N.W.T.

November 18, 1975.

(PROCEEDINGS RESUMED PURSUANT TO ADJOURNMENT)

THE COMMISSIONER: All right, ladies and gentlemen, we'll come to order.

MR. MARSHALL: Mr. Commissioner, if you recall last night you raised a matter pertaining to the consideration of impacts of other facilities within a transportation corridor. I've discussed that with the members of the panel and they would like time to consider your remarks, sir, to look at the transcripts before responding. I have a feeling that they will be with us for a while. We'd like to get back to this point a little later on, if we may.

THE COMMISSIONER: Fine.

MR. MARSHALL: This morning, sir, we have reached the ornithology section of the prepared evidence.

ALEXANDER WILLIAM FRANCIS BANFIELD,
DONALD LAURIE DABBS
WILLIAM W.H. GUNN
RUSSELL ALEXANDER HEMSTOCK
PETER J. McCART
RONALD DANIEL JAKIMCHUK, resumed:

DIRECT EXAMINATION BY MR. MARSHALL (CONTINUED):

Q I would ask Dr. Bill Gunn to present that, sir.

THE COMMISSIONER: Go ahead, sir.

A Thank you, sir.

The purpose of my testimony in this proceeding is to describe the ornithological

baseline studies and disturbance studies which L.G.L. undertook for Arctic Gas along the proposed routes in the State of Alaska and in Canada.

L.G.L. is engaged primarily in the biological aspects of environmental research. We act as consultants to governments, industry and individuals. Apart from the studies related to this hearing, some relevant projects that L.G.L. has undertaken are as follows:

1. Studies of distribution and numbers of birds and marine mammals and fish in the eastern and central Arctic, for the Polar Gas project.

2. A study of possible competition between muskoxen and caribou for food on Banks Island, for the Government of the Northwest Territories.

3. An appraisal of possible effect of highway construction in the Mackenzie River Valley on wetlands and wildlife for the Government of Canada.

4. Ornithological, hydrological and remote sensing studies in the Athabasca Tar Sands region, for Syncrude Canada Ltd.

5. A literature review of the effects of fire on the boreal forest for the Departmen t of Indian Affairs & Northern Development of the Government of Canada.

6. An analysis of bird distribution in and near the Beaufort Sea for the Canadian Wildlife Service.

7. Several studies of environm ental problems at airports in Canada and elsewhere, mainly for the Canadian Ministry of Transport and the National Research

Council of Canada.

8. Studies of bird mortality at tall structures such as chimney stacks, television towers, etc. for several clients.

9. A radar and visual study of coastal sea birds on the Beaufort Sea.

L.G.L.'s first association with Arctic Gas was when our firm was first retained by Williams Brothers (Canada) Ltd. early in 1971. At that time, Williams Brothers was undertaking a feasibility study for a gas pipeline that would run generally from Prudhoe Bay through Western Canada and into the lower 48 states of the United States. Our assignment was:

1. To determine whether or not birds would be disturbed by either construction or operation activities of a pipeline through this area;

2. Whether the extent of such disturbance might be so great as to warrant consideration of a major change in the form of the project being considered; and

3. If not, what the extent of disturbance might be, and how it might be mitigated.

In order to prepare for our ornithological studies, we examined the ornithological literature and found very little about bird populations and distribution along the proposed routes, particularly along the North Slope in the area between Prudhoe Bay in Alaska and the Mackenzie River Delta in Canada.

We therefore considered that

Banfield, Dabbs, Gunn
Hemstock, McCart, Jakimchuk
In Chief

our first task was to undertake what we term "baseline" studies in order to gain a knowledge of bird populations and distribution, the locations of concentration areas, the times of year in which birds occupy these areas, and aspects of their life cycle occurring in these periods, e.g. breeding, raising young, moulting, preparing for migration, migration, and wintering.

We also undertook research involving disturbance experiments that we devised to simulate the types of disturbance that would probably be associated with the construction and operation of a gas pipeline. Along the North Slope, our work geographically encompassed the proposed route from Prudhoe Bay across north-eastern Alaska and across north-western Yukon to the Mackenzie River Delta. We also reviewed the route through the Brooks Mountain Range and across the Richardson Mountains to the Mackenzie River. We also examined the proposed routes up the Mackenzie River Valley and south through the Western Provinces of Canada to the lower 48 of the United States.

The studies which were conducted and the reports which resulted from the studies were done under my overall supervision and direction.

We began our field studies in 1971 and have continued them in '72, '73, '74 and '75, to the present time. We anticipate that studies will be continued in 1976 and beyond.

In order to summarize the objectives and results of these studies as succinctly

as possible, I would first like to present the baseline studies by geographic region and then similarly describe the disturbance studies.

I will deal first with the region, hereinafter referred to as the Northern Region, traversed by the proposed coastal route and the interior alternative route in northeastern Alaska and the northern Yukon. Then I will review the studies undertaken in the region extending south from the Mackenzie River Delta along the proposed route to the 60th parallel north, hereinafter referred to as the Mackenzie Region.

In 1971, LGL conducted aerial surveys of two types in the northern region. Aerial surveys of a general, exploratory nature, were flown to obtain information about bird distribut .ions and to select areas for future ground study. Grid-type aerial transects were also flown along predeterimined routes on the North Slope and the Old Crow Flats in the northern Yukon in order to obtain sample counts of waterfowl and other water birds in these areas. We confirmed that these were important areas for waterfowl. The results are reported in Volume 10 of the Biological Report Series, which deals with all of the ornithological studies undertaken in 1971.

No aerial transects were flown in this region in 1972, but in 1973 aerial surveys were used to study the numbers and distribution of breeding and moultingwater birds along the barrier beaches, spits, lagoons and bays of the Beaufort Sea Coast between Prudhoe Bay and the Mackenzie Delta. Our 1973 study is reported in Volume 26, Chapter 1 of the Biological Report

Series.

In August and September, 1973, 1974 and 1975, aerial surveys were also used to study the numbers, movements and distribution of staging snow geese on the Mackenzie Delta, Yukon North Slope and eastern Alaskan North Slope. The areas that were occupied by snow goose concentrations were plotted on maps to study their relationship to the proposed pipeline route. The results of our 1973 and 1974 surveys are contained in the Biological Report Series, Volume 27, Chapter 1 and Volume 30, Chapter 1, respectively. The results from 1975 are now in the process of compilation.

In 1971, we began ground transects to obtain population indices of terrestrial birds at twenty-two sites along the Beaufort Sea coast, the proposed coastal route, and the interior alternative route. The results of those surveys appear in Volume 10 of the Biological Report Series.

Transportation for ground survey work in 1971 was by fixed-wing aircraft, and this limited the choice of sites, particularly along the interior alternative in the Brooks Mountain Range. Accordingly, in 1972, additional sites along the interior alternative route were surveyed by ground transects through the use of a helicopter and a report of the results is included in Volume 12, Chapter 2 of the Biological Report Series. In 1973 many of the sites selected in 1971 and 1972 were re-surveyed to assess

the extent of natural variation of bird populations in different years. The results of this survey are contained in the Biological Report Series, Volume 29, Chapter 3.

In 1974 our transect program placed emphasis on sampling different habitats to provide further information on bird habitat preference, and bird population indices for different habitat types of the region. The results of this program are published in the Biological Report Series, Volume 30, Chapter 3. Our studies now provide a reasonable index of the species, populations, distribution and relative abundance of the more common land birds of the region.

LGL has also conducted some more selective baseline studies of birds in this region. The North Slope has many lakes of varying size and we felt it important to learn more about the types and numbers of waterfowl and shorebirds they support in summer. Accordingly, twenty-two of these lakes were surveyed in the Yukon in 1972 and sixty in 1973. They were chosen to be representative of lakes along the coastal area from Prudhoe Bay to the Mackenzie Delta. Information was obtained as to bird species, numbers and productivity on these lakes. Statistical comparison of the results enabled us to identify the types of lakes that were heavily used by birds and were highly productive, thus warranting special protection. It also enabled us to identify the types that were little used by birds and were largely unproductive. If lakes

are to be used for water for camp sites, and so on, these latter type lakes may better be selected for water withdrawal, at least as far as birds are concerned. The results of these studies are reported in Volume 12, Capter 1 (1972 study) and Volume 29, Chapter 1 (1973 study) of the Biological Report Series.

A few words about LGL's ground survey methods might be in order here. There are a number of methods of endeavouring to determine the bird population of a given area in a particular period of time. Every method so far devised has its biases and weaknesses, including the transect method we have used extensively. Another method, termed the plot method, measures breeding bird populations by intensive coverage of a relatively small area. A comparison of the results obtained by the two methods for the same area helps to identify the biases and to permit correction figures to be developed for some of the commoner species. In 1973, LGL conducted such a comparative study on the North Slope in the Babbage River Drainage of the Yukon Territory. This reported in the Biological Report Series, Volume 26, Chapter 2.

A highly important ornithological aspect of the Beaufort Sea Coast is the bird migration that takes place east and west along the coast. In 1972, LGL instituted an autumn migration watch at Nunaluk Spit on the Yukon North Coast from July 10th to September 17th. A total of 240,000 birds representing more than fifty species was estimated to have passed within sight of this location in east or

west migration during this period. The report of the study is contained in Volume 13, Chapter 3 of the Biological Report Series.

In the Mackenzie Region extending south from the Delta along the proposed routes to the 60th parallel north, I can say in summary that baseline studies similar to those in the Northern Region were conducted during the period 1971-1974. Preliminary aerial studies were flown in the spring, summer and autumn of 1972. The results of these surveys are contained in Volume 10, and Volume 11, Chapter 1, of the Biological Report Series.

In 1973, an additional aerial waterfowl survey was flown along a proposed route change in the Travaillant Lake area for comparison with data from previous surveys. A report of this survey is contained in Volume 28, Chapter 1, of the Biological Report Series.

With respect to the Prime Route, aerial surveys were flown in 1975 along the proposed Fort Simpson re-alignment.

Rare and endangered bird species form a particularly important aspect of our ornithological studies. In regard to the locations of nest-sites of peregrine falcons, we have worked in close association with the Canadian Wildlife Service, which maintains a working file of all known peregrine nest-sites. Disturbance studies related to the peregrine falcon will be outlined later in my testimony. A concentration of bald eagle nest-sites found close to the proposed pipeline route near the 60th Parallel North has been checked by aerial surveys in 1972, 1973 and 1974. Our 1972, 1973, and 1974 reports are contained in Volume 11, Chapter 2, Volume 26, Chapter 3 and Volume 31, Chapter 3 of the Biological Report Series, respectively.

Ground surveys of the terrestrial bird populations were begun in 1972, using the transect method, at selected sites roughly fifty miles apart along the proposed routes. The results of these surveys are incorporated in Volume 12, Chapter 2, of the Biological Report Series. Such surveys were

continued and extended in 1973 and 1974, to a total of more than forty sites, in order to obtain readings at the same sites in different years and to obtain statistically satisfactory samples of the principal habitats. Our 1973 studies are reported in Volume 29, Chapter 3 of the Biological Report Series and the results of our 1974 studies have been supplied to Arctic Gas. I should add that they now appear in Volume 31, Chapter 1 of the Biological Report Series.

In 1975, ground surveys were extended to include the Cross-Delta alternative route and the proposed Fort Simpson re-alignment route. Results of these surveys are in final preparation.

As part of the inter-disciplinary studies undertaken in the boreal forest at Chick Lake in the Northwest Territories in 1973, 1974 and 1975, LGL has made a comparative study of the results of the transect and plot methods of obtaining bird population indices with useful results. We have submitted such results from 1973 and 1974 to Arctic Gas and the results from 1975 are in final preparation.

Bird migration studies were also undertaken in the Makcenzie Region. Spring migration was studied in the upper Mackenzie Valley in May, 1972, and the results are reported in Volume 13, Chapter 1 of the Biological Report Series. Spring migration was again studied in the central and upper Mackenzie Valley in April and May, 1973, and the results are reported in Volume 28, Chapter 2 of the Biological

Report Series. Autumn migration through the same region was studied in 1972 and the results of that study are contained in Volume 13, Chapter 2 of the Biological Report Series. One important point established by these studies was that in spring, waterfowl tend to follow closely the Mackenzie River which opens before the adjacent icebound lakes, and they make considerable use of the islands in the lower river for feeding, nesting and mating. By contrast, in autumn the lakes are still open and provide good food sources; in consequence, they are extensively used by migrating waterfowl.

This concludes my review of the baseline ornithological studies conducted to date. Now I should like to describe the disturbance studies that we have conducted.

I should first explain the rationale underlying our approach to the bird disturbance studies. We reviewed the literature, but could find no reference to comparable disturbance studies. Therefore, we had to devise our own techniques for experiments to be conducted under field conditions. We considered the types of disturbances likely to arise from the construction and operation of a gas pipeline and divided them into three categories:

1. human presence and activity;

2. aircraft activity; and,

3. noise, such as would arise from the operation of a compressor station

or from construction equipment and machinery.

Nearly all our experimental disturbance studies took place on the Yukon North Slope.

The first such study related to human presence and activity was conducted in 1972 at a camp on the Firth River in the Yukon Territory where about 20 people were working and there was a good deal of activity. Three experimental plots were laid out on the dry tussock tundra close to camp and similar control plots were laid out some distance away. A study of breeding bird populations and reproductive success was made on both series of plots and the results compared. The Lapland longspur was the only species present in sufficient numbers to provide an acceptably large statistical sample. There proved to be no statistically significant difference in the number of pairs of longspurs nesting in the two series of plots, but the reproductive success on the experimental plots was lower to a marginally significant degree compared to the control plots. The report of this experiment appears as part of Chapter 3, Volume 14 of the Biological Report Series.

In 1972, we also conducted a combined human and aircraft disturbance studies of nesting birds on the Barrier Beach. The presence of humans affected incubating behaviour and could have adversely affect reproductive results if carried on for any length of time. Results of this study were reported in Volume 14, Chapter 4 of the Biological Report Series.

A number of different types of aircraft disturbance studies have also been carried out.

In 1972, an aircraft disturbance study was carried out at the Firth River Camp in parallel with the human disturbance study and the results were similar. Helicopters were regularly flown over experimental plots at low levels and the number of breeding pairs and reproductive success was compared with findings on the control plots. Again, the Lapland longspur was the only species present in sufficient numbers for a statistical analysis. The number of breeding pairs of longspur was not statistically different between experimental and control plots, but the lower reproductive success on the experimental plots was marginally significant.

THE COMMISSIONER: Excuse me, Dr. Gunn, that is the second time--

A Yes sir.

Q --You used that expression "marginally significant". You used it before.

A Yes sir.

Q In relation to the study of the breeding near that camp.

A Right. Would you like me to explain what I mean by "marginally significant"? It's really an accepted way of describing the results as obtained on a percentage basis statistically, and it's a matter of probability. If your results give you figures which indicate that say such results could

be obtained by chance only once in 100 times, you would consider that to be quite significant or just significant. But if results indicate that by chance such a result could be obtained say once in 20 times, then it begins to be not quite so certain and I would classify that as marginally significant. There is a probable significance, but because it could happen by chance say once in 20 times, then it's not as positively significant as if it were only once in 100 times.

So in this case the results that we got were such that it could have arisen by chance say once in 20 times and we think it significant but we put the word "marginally" in there because there is a possibility that simply by pure chance it might have happened.

Q I understand that last sentence or two, but the numbers confused me. Well, let's get this straight, if we can. You said that the reproductive success of the experimental plots was lower than on the control plots.

A Yes.

Q Now, you didn't feel that you could ascribe that to chance, the probability was that it was owing to the disturbance factor but it might have been something that occurred by chance. That's essentially what it means?

A Yes sir, that is true, and the possibility that it might have occurred by chance was a once in 20 times. If it had only been once

in 100 times, then we would have considered it to be highly significant, or more than 100 times.

Q You know that I follow you until you use "significant to something to the chance that seems most insignificant." That's what is throwing me off here,.

A It's the converse, sir, that if through chance it occurs only once in 100 times, then if that number comes up through the experiment we consider it highly likely that the result was caused by disturbance.

Q I'm with you, all right, I follow you. Carry on.

A All right, sir.

THE COMMISSIONER: They're all pretending they understand.

MR. MARSHALL: Some of us get up earlier than others, eh.

A Those last results were reported in Chapter 3, Volume 14 of the Biological Report series. A re-reading of these plots by the transect method in 1973 gave some indication of persistence of effect in terms of relatively lower numbers of pairs of longspurs on the experimental plots in the following year as is reported in Volume 26, Chapter 4, of the Biological Report series.

In the Barrier Beach experiment of 1972 on nesting birds, aircraft overflights produced the following results: Helicopters

(at 1,000 feet) were more disturbing to birds than fixed-wing aircraft (accordingly, I would prefer that where possible fixed-wing aircraft be used rather than helicopters); non-incubating birds showed a greater intolerance than incubating birds; black brant, glaucous gulls and Arctic terns were clearly affected, but incubating common eiders less obviously so. The significance of that, sir, I think, is that if the birds were sitting on eggs and incubating, they were less likely to leave them than if they were not sitting on eggs. The results of this study are reported in Volume 14, Chapter 4 of the Biological Report series.

In June of 1972 a light aircraft on floats was used to disturb waterfowl on a small lake and a large lake on the Yukon North Slope. The results of these studies are contained in Volume 14, Chapter 1 of the Biological Report series. Similarly, we conducted a study on a lake near Inuvik in the Northwest Territories, that is used as a base for float planes. This is reported in Volume 14, Chapter 6 of the Biological Report series. These studies showed that some water birds evidenced a tolerance to float plane traffic, while others did not.

The effects of aircraft disturbance on moulting sea ducks were examined at Herschel Island, Yukon Territory, in August of 1972 and '73. Helicopter overflights at 100 meters (330 feet) caused an immediate but apparently non-persistent effect. Overflights at 300 meters (1, 000 feet) did not appear to disturb the sea ducks. They were not driven from the

area in either case. The results of our studies are published in Volume 14, Chapter 5, and Volume 29, Chapter 2 of the Biological Report series.

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Jakimchuk, McCart.
In Chief.

The effects of disturbance of flocks of snow geese by aircraft were examined on the North Slope in 1972 and 1973. Snow geese were found to be fairly sensitive to the presence of aircraft, showing evidence of disturbance by flushing at a mean distance of 1.6 miles from small aircraft, 2.5 miles from large aircraft, and 2.3 miles from small helicopters. In terms of aircraft altitudes, geese were observed to flush in repsonse to aircraft altitudes of 8000 to 10,000 feet, the maximum height at which the plane was flown. Deliberate hazing of flocks in an area approximately five miles by ten miles cleared out the geese in about fifteen minutes. The results of our 1972 study are published in Volume 14, Chapter 7 and of our 1973 study in Volume 27, Chapter 2 in the Biological Report Series.

The study in 1973 determined that undisturbed snow geese spent 57% of daylight hours feeding. For juveniles this was 65 to 70%. Geese flushed farther from ehlicopters than light fixed-wing aircraft. Experimental flights at both two-hour and one-half hour intervals indicated some partial accommodation to frequency. Disturbance from existing aircraft traffic in 1973 averaged 0.25 flights per daylight hour. Analysis of our data on rates of disturbance and the acquisition of energy reserves by juvenile geese indicate that a potentially severe problem could arise if the rate of aircraft flights were allowed to rise to 0.5 flights per hour, Biological Report Series, Volume 27, Chapter 2.

The results of the snow goose experiments in 1972 led to a study in 1973 of the bioenergetics of snow geese on the North Slope during the autumn staging period, August 15 to September 30. During an average stay of eighteen days, geese increased their body weights in the range of 9 to 23% and their fat reserves from 45% in adult males to 117% in juvenile females. This is reported in Volume 27, Chapter 4 of the Biological Report Series. This study indicated the importance of the staging area to snow geese in their preparation for the long migration southward. In 1975, however, our studies indicated that because of an early snowfall, snow geese were able to make very little use of the North Slope and remained principally in the Mackenzie Delta.

Another aircraft disturbance--

THE COMMISSIONER: That is they used the Mackenzie Delta as their staging area before heading south?

A Yes, sir.

THE COMMISSIONER: Yes.

A That's correct. On September 5, there was a snowfall that left four or five inches on the North Slope and they largely withdrew to the Mackenzie Delta.

MR. MARSHALL: Dr. Gunn, perhaps you could just give some detail as to where in the Mackenzie Delta they concentrated in 1975?

A In 1975, there was also snow

on the outer fringes of the outer delta and the snow geese, and there are about 350,000 of them, tended to concentrate in a band across the more southernly parts of the outer delta from Shallow Bay in the west across to Kittigazuit Bay in the east. The band across there, which was not all snow-covered, there were still green areas open, they stayed out of the forested area to the south, the inner delta, but they were in a band across the outer delta.

THE COMMISSIONER: About 350,000 of them?

A Yes, sir.

THE COMMISSIONER: And are you familar with the route that Arctic Gas proposes to take across the mouth of the delta?

A Yes, sir.

THE COMMISSIONER: Where were they in relation to that route?

A They were very close to it, sir, on both sides of that route.

Another aircraft disturbance study was begun in 1974 with the commencement of two to three year study of diurnal raptors, golden eagle rough-legged hawk and peregrine falcon, with specific emphasis on gyrfalcons that nest on the North Slope of the Yukon Territory. We have also surveyed the North Slope in cooperation with the Canadian Wildlife Service for occupancy and productivity of gyrfalcons. Gyrfalcons, although rare, are not endangered but are closely

related to the rare and endangered peregrine falcons whose few remaining active nest sites in North America include a small number in the Alaskan and Yukon North Slope and Mackenzie Valley regions. By extrapolation, it is hoped that what is learned about the aircraft disturbance thesholds of gyrfalcons can also be applied to the peregrine flacon and other nesting raptors such as the golden eagle. In 1974, it was found that helicopter passes at 500 feet altitude caused incubating birds to leave their nests even at low temperatures in March and April. At 1000 feet, birds remained on the nest but showed indications of stress. The study was continued in 1975 with particular emphasis on finding height and distance disturbance thresholds. The results of our 1974 study of raptors have been supplied to Arctic Gas and I should say that they are now reported in Volume 30, Chapter II of the Biological Report Series. Preliminary results from 1975 indicate that overflights at 2000 feet above ground level are above the threshold of visible disturbance.

In our noise disturbance studies, we used gas compressor sound simulators designed to reproduce frequencies and intensities of sound developed by a 20,000 horsepower gas compressor station. Our first experiment was carried out near the Babbage River, Yukon Territory, in June of 1972. We set up the sound simulator and established experimental bird plots in the immediate vicinity. At some distance, we also set up control plots. The sound was run continuously through

the nesting period and censuses of the birds nesting in all plots were taken and compared. The Lapland longspur was the only species present in sufficient numbers to provide a statistical comparison. There was no significant statistical difference in the numbers and reproductive success of this species between the experimental and control plots. The results of this study are reported in Volume 14, Chapter 2 of the Biological Report Series.

In September 1972, the sound simulator was set up in the vicinity of Komakuk Beach, Yukon Territory, in an area frequented by flocks of snow geese. Decoys were set out within the range of the sound simulator to attract geese. The behaviour of geese was studied when the sound simulator was operating and when it was not operating. It was found that goose flocks did not feed any closer than 1.5 miles from the simulator when operating, and birds flying over the simulator were frequently diverted from their course by as much as 90 degrees or greater. This study was reported in Volume 14, Chapter 8 of the Biological Report Series.

A similar study was conducted in August and September of 1973 in the same area. In this experiment, and in the 1972 experiment, the sound simulator was only operating at about half of its maximum volume. During the period of this experiment, feeding flocks of geese approached no closer than half a mile to the simulator's north side where the sound

was most intense. Flocks flying overhead were also diverted but in this case considerably less than 90 degrees.

From these last two experiments it is evident that geese are unlikely to land and feed within about 1.5 miles of a gas compressor station and that they may be diverted while in flight, but their passage across the area of a gas compressor station will not be prevented. Results of this study were reported in Volume 27, Chapter 3 of the Biological Report Series.

From the results of our surveys and experimental studies, we have been able to identify some sixteen ornighologically sensitive areas along or close to the proposed prime route or primary alternatives to the route between Prudhoe Bay and northern Alberta.

Dealing with these by region, I will attempt to delineate the area, and state the type of birds involved and the relevant period of the year.

Beginning with the portion of the Prime Route between Prudhoe Bay and Mackenzie Delta, the following five areas are considered ornithologically sensitive at certain times of year:

1. Beaufort Sea coast, including bays, spits, lagoons and barrier islands; used by large numbers of migratory, breeding and moulting waterfowl, other water birds, and shorebirds, between May and October.

2. Wet sedge tundra extending east and south from Prudhoe Bay for a dis-

tance of about 50 miles; an important breeding area for shorebirds and some water birds, from the end of May to the end of September.

3. Willow thickets bordering northward flowing rivers on the North Slope between Prodhoe Bay and the Mackenzie Delta; used as wintering areas by ptarmigan from November to April.

4. Major portions of the North Slope eastward from the Canning River to the Mackenzie Delta; used by snow geese from mid-to-late August until late September, occasionally until mid-October.

5. Certain steep valley slopes and promontories along the foothills of the British mountains from the Alaskan border to the Mackenzie Delta; used as nesting sites by gyrfalcons (March to July) and other raptors from May to August.

Along the Interior Alternative route, there are two areas notably sensitive:

1. Steep valley slopes of the Canning River, used as nest-sites by gyrfalcons from March to July, peregrine falcons and other raptors from May to August.

2. The Old Crow Flats, an important staging and breeding area for waterfowl.

The whole of the Mackenzie Delta is ornithologically sensitive; the outer delta is a staging and breeding area for whistling

swans, three species of geese, and other water-related birds such as sandhill cranes from mid-May to October; the inner delta is a prime staging, breeding and moulting area for ducks, shorebirds and land birds.

Southward along the Prime Route up the Mackenzie Valley, sensitive areas are more restricted and are made up chiefly of two types -- those involving raptor nest-sites, and those involving staging and nesting sites for waterfowl.

There are nest-sites of the endangered peregrine falcon and other raptors along the proposed Prime Route in the Campbell Hills and in the vicinity of the Arctic Red River, and also in the Norman Range and (probably) the McConnel Range of the Franklin Mountains. Of these, it is known that at least 11 lie within 3 miles of the proposed route.

On the Mackenzie River, the islands and sandbars from Arctic Red River south to Wrigley are key resting and copulating sites for migrating swans, geese, ducks and shorebirds in spring in May and June.

Two clusters of small to medium-sized lakes north and south of Norman Wells and another about 30 miles southeast of Fort Simpson are productive nesting and important moulting sites for waterfowl.

In general, there are three principal methods of avoiding or mitigating impacts on these ornithologically sensitive areas

during the construction and operation of a gas pipeline. One is through design and control of methodology. The second is through selective timing, particularly through the various phases of construction. The third is through spatial adjustment of the routing, the supporting facilities and the associated activities.

LGL's numerous recommendations to Northern Engineering Services and Arctic Gas incorporate aspects of all three of these methods.

For methodology, the principle is to construct and operate the pipeline in a manner that will cause the least short-term and long-term disturbance to the existing environment. Often this may not be the easiest or cheapest or most straightforward way, but in our view it is the way that will produce the best results for ourselves and for other living things, birds included.

Because most bird activities and distribution are highly seasonal, selective timing is usually the most practical approach to accommodation, and basically this means recommending that as much of the activity as possible be undertaken during the winter months when most birds are absent from the region.

Of the remaining activities that must be carried on during the summer months, many are of the type that could have detrimental effects on bird populations of certain sensitive species and in certain sensitive locations of major importance to birds, as mentioned above. As means of

avoidance or mitigation, we are now left with spatial adjustments in the routing or location of facilities or in operational techniques such as the control of aircraft flight plans. These adjustments could range all the way from selection of one alternative routing over another, through minor adjustments in location of facilities or pipeline routing, to control of routing and frequency of aircraft flights and ship movements.

Let me now give some examples. In describing our disturbance experiments, we mentioned three principal forms: human presence, noise and aircraft.

In our view, human presence is one of the most serious causes of disturbance to birds, and one to which some birds will accommodate very slowly, if at all. In winter, when most birds are absent, there is little concern except in the special cases of ptarmigan overwintering in willows of stream valleys and of gyrfalcon nest-sites, which begin to be occupied as early as February. From May through October, however, especially on the tundra with its high visibility, human presence should be as inconspicuous and infrequent as possible. Personnel working on staging and facility sites should confine themselves to those sites and not go wandering over the countryside. In particular, the coastal spits and barrier beaches of the North Slope should be avoided.

We believe that most birds will accommodate fairly well to most types of

noise likely to be associated with construction. In the case of gas compressor stations, a special effort should be made to attenuate their sounds in areas on the North Slope and the Mackenzie Delta at locations frequented by geese and swans. We have tentatively set a maximum level of 50dB on the A scale at a distance of 1000 feet as being acceptable. If in practice, this level turns out to be say, 56dBA at 1000 feet, this simply means that the disturbance area might have a radius of 2 or 2 1/2 miles, instead of about 1 1/2 miles.

Three of these stations -- compressor stations -- CA-03, CA-05, and CA-06, have been located in areas known to support concentrations of snow geese during the fall staging period. Two of these are also close to small clusters of rare and endangered raptor sites. We have recommended shifts in location for these stations to mitigate the probable disturbance. A similar situation exists with respect to rare and endangered peregrine falcon nest-sites on the slopes of the Norman Range close to compressor sites and valve stations.

At one time we were considerably concerned about the chronic hazard to migrating birds presented by antennae and communication towers, some of which were designed to exceed 300 feet. This was especially true for those planned for the Mackenzie Valley and the tundra and Beauford Sea coast. However. we have been given to understand that a satellite communication system is now planned to take the place of the conventional system requiring towers.

Because of the known sensitivity of raptors, waterfowl and other birds to fixed wing aircraft and helicopters, we have made detailed recommendations regarding aircraft routing, altitudes and frequency of flights in the vicinity of areas of concern, such as the bald eagle nesting lakes near the 60th Parallel, the islands in the lower Mackenzie, known raptor nest-sites along the route, the Mackenzie Delta, the North Slope, and the Beaufort Sea Coast. Perhaps most interesting and of greatest concern is the effect of passing aircraft on snow geese during the staging period on the North Slope from mid-August to early October. During this period, we have calculated the present air traffic overflying goose flocks as 0.25 flights per hour. From our observations of their behaviour and a physiological study of their energy requirements, we have calculated that a potentially serious impact could occur in juvenile geese if this rate were allowed to increase to 0.5 flights per hour. This could come about through a combination of reduced feeding time and increased energy consumption as a result

of disturbance. We have therefore recommended that flight frequency be limited in this period to 0.25 flights per hour, but this is a matter that would have to be controlled by the Ministry of Transport and the U.S. Federal Aviation Administration rather than simply by Arctic Gas.

Our recommendation for minimum altitudes for aircraft activity over ornithologically sensitive areas is 2,000 feet above ground level but even this height is insufficient to prevent disturbance of geese and spacing of flights will be required to mitigate disturbance.

I would now like to conclude by making a few comments on our preferences and recommendations regarding alternate routes.

We had no preference in regard to the alternatives on the east and west sides of the Mackenzie River, and we prefer the Fort Simpson by-pass to the previous prime route section, so that no problem has arisen there in either case. On the other hand, we expect that our ornithological recommendations of the interior alternative route over the prime coastal route may run against the grain of engineering and economic and other environmental preference.

Ornithologically, the choice between the interior alternative and the coastal route boiled down to a very few factors. On the interior route the principal concern has to do with about 15 important raptor nest sites, two or three of them being peregrine falcon nests, chiefly in the Canning Valley

in Alaska, and all within three miles of the proposed route. Because of the topography, little accommodation can be afforded through minor route changes. Plans call for two winters and two summers of construction in the Alaskan sector and so these nest-sites would be subject to considerable disturbance for two nesting seasons, perhaps causing some birds to desert the nest or young. Other ornithological concerns along -- I had to change that word "environmental" to "ornithological" -- concerns along the interior alternative are relatively minor, but it also has the advantage of avoiding the Mackenzie Delta.

There are 10 or 12 important raptor nest-sites, two or three of them of a rare and endangered species, peregrine falcon, along the prime coastal routes, but they should receive less disturbance because pipe-laying would take place during one winter. Some summer activities in their vicinity are to be expected, however. The principal ornithological concern on this section of the prime route is the possibility of any factor or combination of factors that would have a detrimental effect on the viability of the Beaufort Sea coast as a multi-purpose facility for birds. Our idea of the worst possible ornithological scenario that could arise from pipeline activity would be serious, prolonged environmental damage to this ecosystem. We are aware that such a possibility is remote, but because it cannot be entirely discounted, we prefer to go with the more probable but more limited hazards of the interior alternative.

THE COMMISSIONER: Excuse me, Dr. Gunn.

A Yes sir.

Q When you're talking about the Beaufort Sea coast, you're talking about the Prudhoe Bay right over to and including the Mackenzie Delta, is that --

A No sir, in this context we are covering it to the western edge of the Mackenzie Delta, yes.

Q Dr. Livingston gave evidence in the overview days of the hearings and his concern appeared to be identical, though not as elaborately articulated as your own now. I gather you are a colleague of his, from what you say.

A Yes sir, he used to be a partner in our firm.

Q Oh, I see. Carry on.

A All right, sir.

In sum, while we prefer the interior alternative route, we believe it is possible to build the proposed gas pipeline along the prime route -- and by this I mean the old prime route -- without serious long-term damage to bird populations, but only if our recommendations are carefully followed and that particular cate is taken to avoid pollution along the Beaufort Sea coast. I have examined the DINA Northern Pipeline Guidelines, and the applicable N.E.B. regulations, and from the perspective of my discipline, I think the pipeline can be built to

conform with their intent.

Q Dr. Gunn, I believe you have some slides you would like to present now.

A Yes sir, if you wish I have some slides I can show, it will take about ten minutes.

Q Yes, certainly. Just before you do that, the -- you packed a great deal into these pages and it's certainly all, I think are very interested in the subject. Just looking at your very last paragraph here, the reason that you would prefer that they go through the interior of Alaska and the interior of the Yukon is because you want them to stay away from the coast. That's --

A Yes sir.

Q And that's because the coast is the nesting ground for many species and the staging ground for the snow geese, that come from the Arctic Islands.

A The slope is a staging ground for the snow geese in fall between mid-August and early October. The coast itself is a migration route, a two-way migration route. Some birds travel from west to east, some from east to west, both in spring and fall. Birds nest along the coast and they also use it as moulting areas and staging areas preparatory to migration.

Q Now, there's two things you might just think about, and as I say, deal with them later in the week as Mr. Marshall suggested, or

not at all if you don't wish to; but the one is that the prime route that Arctic Gas now wants to build a pipeline along is a route that goes along the North Slope of the Yukon, and then across the mouth of the Mackenzie Delta. You're familiar with the route?

A Yes sir.

Q So that given that prime route, you may want to indicate or you may not want to, but if you do I'd appreciate it, whether that alters your opinion you've expressed in the last paragraph.

A The result of our study this year, sir, they haven't been completely analyzed but from what I know now, I have serious reservations about the cross-delta route.

Q All right. Now the other thing that concerns me, and I talked about this last night, is that, for example the present rate of over-flights on the North Slope is 0.25 per hour. I think you said that.

A Yes, they are. Those figures were taken at the time of year when the snow geese were on the slope, that is mid-August to -- the end of September.

Q Now, what concerns me is this. You said that your recommendation was that overflights should be kept during that period of the year at that level.

A Yes.

Q That if they doubled, that is if the frequency of flights doubled from .25 to .5 per hour, there could well be serious disturbance.

A Yes.

Q I think that's what you said. Now, if all that there were proposed, if all that were going to happen on the north coast were simply the building of this gas pipeline, I suppose that the Minister of Transport and so on and so forth could restrict flights but what concerns me and I think should concern all of us is that Mr. Blair, the President of Foothills said that the -- if you build a pipeline, you get enhanced oil and gas exploration activity which seems logical.

So you would then concievably have enhanced oil and gas exploration activity on the north coast and much greater use of aircraft and you might control the whole situation with a gas pipeline and then find afterwards that you were running into difficulties because of enhanced oil and gas exploration activity and then, of course, you might at some time in the future face the second gas pipeline or an oil pipeline.

Well, you don't have to

deal with those questions now and you don't have to later on if you don't wish to but what concerns me is that you have done an obviously an extremely thorough analysis in relation to the gas pipeline but none of us should treat the gas pipeline as if that was something that could be allowed to occur and nothing occur thereafter. That's -- you see the problem -- and you might wish to think about it.

A Yes, sir. Well, the same results and principles will apply in my view as it's necessary to maintain spacing of flights and to not to allow it to increase to the .5 level but this is only the period from mid-August to early October and whatever happens up there, I feel that for the safety of the geese that the intensities of flight need to be kept to that maximum.

Q Yes, oh I quite understand and it's not just a case of limiting -- of making sure we don't limit our consideration simply to the gas pipeline -- to make sure we don't limit it simply to birds because someone is on this panel, I suspect, is going to say well, earlier in the year, from the beginning of May to mid-June, you can't have any overflights over the North Slope in excess of a certain frequency because the caribou are calving.

At any rate, let's go ahead and have the slides.

A If, I may, sir, I'll come down there and work the projector. I don't cover the whole subject but I do illustrate a few of the

points I am talking about.

Most of our work, sir, entails standing at one point watching birds go by or watching their behaviour or alternatively walking along certain preselected routes to see what birds are there.

This stalwart fellow is standing at a vantage point near Norman Wells watching spring migration, watching birds go over such as these snowgeese coming north in the spring and of course, most of the traffic is much lower down the water fowl and other birds are going past him at lower levels.

This is a typical campsite on the North Slope with our little group of tents in the foreground there. And from there, we have done transects to see what birds are there at that time of the year.

Here we are walking across the tussock tundra. And birds that commonly turn up are birds such as this rock ptarmigan , and golden plover, and this is the Lapland longspur that I talked about, a small songbird that is very common in that area.

Where willows begin to take on a shrubby experience, there is another kind of ptarmigan there, the willow ptarmigan, it is one of the common birds on the tundra.

The lakes of the tundra area are occupied by birds such as these Arctic loons as soon as the ice goes off. This is a northern phalarope commonly found there in summer. It's a type of shorebird.

And there are many sandpipers such as this semi-palmated sandpiper and this stilt sandpiper, a little larger. And there are three types of jaeger there. Jaeger is a relative of the gulls. It is a predator. This is the long-tailed jaeger.

As we look at these lakes and studied their productivity, we found that lakes such as this with steep banks and not much vegetation along the edge with rather straight edges were much less productive for birds than lakes such as these with gentle slopes and streams coming in or leaving and vegetation along the edge.

The vegetation along the edge is important for many young birds such as these young swans. The barrier beaches, as I mentioned were also important to birds, particularly as they provide sheltered lagoons and here in the bottom right-hand corner, you see some water fowl resting and sheltering on the edge protected from the ice out in the Beaufort Sea.

Here again, near Herschel Island are some old squaw ducks, some of them, many thousands that spend part of the summer there, moulting in the sheltered areas.

White-fronted geese move along the Beaufort Sea coast in considerable numbers and here are Brant geese, feeding on an islet at Demarcation Bay.

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Other birds along the edge of the Arctic include the Arctic tern which comes all the way from the Antarctic to nest up here in the summer.

And the snow bunting, another small songbird which I link with the Lapland longspur. These are the two of the more common songbirds in the Arctic and they nest in the bits of flotsam jetsam along the beaches.

Up in the mountains, we had a look at these areas as we said in the Brooks Range in the British Mountains. There are not a great many birds there. One of the common small birds is this pivot found through the mountains and we mentioned the raptors that nest on the cliff slopes in the mountainous areas, in the rocky outcrops, not only along the Brooks Range and the British Mountains, but down through the or up the Mackenzie Valley.

This is a peregrine falcon and as you can see, it is a picture of a captive bird but it shows the bird very well.

This is the gyr falcon that we studied in some detail. And here is our falcon specialist using his tent as a blind to study their behaviour for long periods of time and he was up there starting as early as February doing that in forty below weather. Already at that time, the gyr falcons are starting to use their nest ledges.

Here he is putting bands on young gyr falcons at a time when their sufficiently

close to fledging this disturbance isn't likely to affect the productivity and he is doing that with the approval of the Canadian Wildlife Service who supply the bands.

This means that if they are encountered later, somewhere on the slope, we'll know their origin and we'll know how they disperse from the nest-sites.

THE COMMISSIONER: I take it he climbed up to that. Did he have a rope there?

A Yes, he lowers himself with a rope down -- either climbs up or lowers himself down. It's a fairly precarious thing to do, but he managed to do it quite successfully. It doesn't look like a very strong rope but it seemed to get him up and down.

Of course we were also in the boreal forest and in places that's dense going, in the valleys and the forest and the lakes in the boreal forest. The birds there are somewhat different. The loons now are the common loon and we come across some of the forest owls like this hawk owl, and many smaller birds. This is a gray jay or Canada jay or whiskeyjack, and they were very interested in what we did, so much so in fact that we tended to consider them more numerous than they actually were because they always turned up to see what we were doing. Then there were very many types of perching birds represented here by yellow warbler which comes up from Central and South America to nest near the forest edges and the boreal forest itself.

AS I mentioned, the islands in the Mackenzie River are particularly important to waterfowl migrating northward in the spring. This particular shot is of the sny, what they call the sny, the back part of the river behind Fort Simpson which is, as you know, on an island. It's important to birds in the spring and when the barges go down there, by the

time they go down the birds have already departed, so they are unlikely to disturb the birds. The traffic we have to watch is the local traffic just after breakup.

We also looked at birds that frequent inhabited areas such as these gulls and ravens and in some places even longtailed jaegers. It's very important that where there are camps and people congregating that waste disposal is very effective, otherwise we get birds coming in from the wild and becoming semi-domesticated and scavenging on garbage and food scraps and in the long-term becoming more numerous than we would want them to be.

Now I'd like to show a sequence of slides dealing with the snow goose situation. This is a pair on their nesting grounds, and they nest -- the population that we deal with, nest very largely on Banks Island across the Beaufort Sea to the north-east, and after they have nested and the young are able to fly, and the adults have moulted, they fly down to the Mackenzie Delta, and some of them directly to the North Slope, and we see a flock here on the North Slope feeding, and the place at which the photograph was taken was less than five miles from the seacoast, so you can see that there's quite a narrow area in this region between the coast and the mountains, and the birds have to funnel their way through that westward and then return eastward.

Here is a flock, some on the ground feeding, some leap-frogging forward to establish

a new feeding area. The same kind of thing, the birds on the ground are alert, you can see their heads are up and they are concerned with the photographer's presence.

Some of these flocks can be very big, like many of them are. This is a quite typical flock on the North Slope at that time of year. When you look on the ground and see where they've been you can find out where they've poked into the ground to get the shoots and rizzom, sedges, cotton-grass, and in retiring when they vanish they leave droppings which act as fertilizer. They are also interested in berries. This is at the head of the pen is a crow berry which is a favorite of theirs, and this reddish plant is bear berry, it also produces berries and they are favored by the geese. You can tell what they're feeding on. The blue droppings come from eating fruit, and the grey droppings from eating sedges. You can see here where they have fed intensively in areas and pretty well eaten some areas clear.

Here is an area where a goose has been feeding and it's a marked contrast to the vegetation around it. In some cases where feeding is very intensive, they almost clean off the polygons, such as this one. This is a long-distance view showing our two sound simulators in the middle ground on the left, pointing out over the slope and we observe the behaviour of geese in the vicinity of these things while they were running.

The cloud overcast is quite

typical of that time of year, and presents problems to aircraft. Then we of course also did aircraft experiments, watching the effect of overflights on flocks such as these. That's all I have, sir.

THE COMMISSIONER: Well, thank you very much.

MR. MARSHALL: Could we have the morning break at this point?

THE COMMISSIONER: Yes, I guess we might as well.

(PROCEEDINGS ADJOURNED FOR A FEW MINUTES)

(PROCEEDINGS RESUMED PURSUANT TO ADJOURNMENT)

THE COMMISSIONER: We will come to order again ladies and gentlemen.

MR. MARSHALL: Mr. Commissioner, Mr. Jakimchuk will now present his evidence pertaining to mammals.

MR. JAKIMCHUK: The purpose of my testimony is to discuss the Applicant's proposed pipeline project in relation to its effect on mammals in the areas which would be traversed by the coastal pipeline route and the alternative interior route. In this regard I have considered the impact of the construction, operation and maintenance of the proposed pipeline and related facilities.

For the reasons, which I will develop, it is my opinion that if the proposed pipeline is constructed, operated and maintained in accordance with the construction and operation and maintenance plans contained in Section No.'s 13a and b, they will have no major adverse impact on mammals in the area and the anticipated impacts will be minor and local in nature.

Our involvement as consultants in this project commenced in early 1971. We were assigned the responsibility for mammal studies and commenced our filed work in March of that year. At that time our client was Williams Brothers Canada Ltd., predecessors of Northern Engineering Services Company Limited, the principal consultants of the Northwest

Project Study Group.

Our studies were broken down initially into two functional categories: studies of the Porcupine Caribou herd and studies of furbearing mammals such as beaver, muskrat, marten and Arctic fox. In fact, the scope of our studies have included all major mammalian taxa: ungulates, carnivores (large and small) and rodents.

The geographic area of study was extremely large and was oriented towards characteristics of the species of major importance as well as various routing alternatives including the coastal route, interior route and routings along both the east and west side of the Mackenzie River. In 1972 our studies were extended to include proposed routings in north-eastern Alaska and have continued in both Alaska and Canada since that time.

Our initial studies consisted of baseline surveys of populations and habitats. I will elaborate on the studies and their rationale later in my testimony.

During 1971 and 1972 I was personally involved in establishing study objectives, planning research, periodic field inspections, including participation in surveys; data analysis, report writing and editing. Subsequently my role was more heavily oriented to general supervision, editing and planning of projects.

We were able to draw upon the

vast experience and expertise of Dr. Frank Banfield, advisory consultant to Canadian Arctic Gas from the outset of our studies, both for planning of programs and review of results and methodology.

Our initial studies were broadly based and not route-specific since we required a systematic baseline of mammalian fauna. In addition this allowed us to cover areas which, subsequently became route alternatives or where route alterations were made. Our study objectives were modified over the years as we were able to identify possible interactions between mammals and the pipeline routing as changes occurred and as engineering and design information was more completely developed.

The study area in the Yukon was extensive, primarily reflecting the wide range of the Porcupine Caribou herd. The area included the entire territory north of the Ogilvie Mountains to the coast. The study area also included a wide corridor on either side of the Mackenzie River in the Northwest Territories and corridors along the proposed routings in Alberta and British Columbia.

Mammal study areas generally encompassed the home range of animals which could be encountered or the extent of habitat which could be affected during pipeline construction and/or operation.

Hence, studies of highly mobile species such as caribou, grizzly bear, and wolves were wide ranging. Studies of furbearing mammals were more

restricted to habitats near pipeline routes.

Our major objectives were four-fold:

1) Gather baseline data on mammal populations and habitat;
2) To identify potential interactions between pipeline routing and mannal habitats and populations;
3) To assess the significance of these potential interactions, and;
4) To gather sufficient information to make recommendations regarding scheduling of construction, routing and mitigation of disturbing interactions.

Our rationale underlying the mammal studies was to carry out habitat-oriented studies for small mammals such as mice and fur-bearing species such as marten and beaver since they are more habitat specific than the large species such as caribou or grizzly bear. For the latter we focused primarily on the population because of the higher degree of mobility of these species and the large area in which interaction could take place along the proposed routings. Our studies were also based on the importance of a species or groups of species taking into account either their role in the ecosystem, their social or aesthetic importance, or their potential vulnerability to disturbance.

Our approach to studies of the

various mammal species which might be encountered by the pipeline, was governed by their anticipated vulnerability to impact during pipeline construction and operation. Abundant, large, gregarious, highly-mobile mammals such as caribou were considered most vulnerable and consequently were studied intensively.

Initially our emphasis was on baseline investigations of populations and habitats. This provided us with essential information upon which to assess potential interactions and the relative importance of these. Following the acquisition of baseline information, we carried out what might be called problem solving and experimental studies on individual species such as caribou and Dall sheep. In these studies we gathered quantitative data on such factors as disturbance by aircraft, caribou utilization of seismic lines and winter roads and the effects of compressor station noise levels on the behaviour and activities of caribou and Dall sheep.

METHODS Study methods varied considerably according to research objectives. Both intensive and reconnaissance aerial surveys were carried out to obtain baseline information on habitats and populations. Site specific surveys were carried out on foot and by boat, and field camps were established for longer term site specific studies in remote areas. Each report in the Biological Report Series presents the specific methods, techniques and experimental design employed for the individual study. Major logistic

bases were Old Crow, Arctic Village and various communities along the Mackenzie Valley.

Major groups have been separately studied, and intensive studies have been carried out on important species representative of major taxonomic groups. These are microtine rodents, large carnivores, aquatic and terrestrial fur-bearers and ungulates. Specific studies were not conducted on species such as otter or wolverine either because of their low numbers or widespread distribution within the study area, or because potential impacts were considered to be negligible or non-existent. Studies on microtine rodents were conducted to investigate a group of mammals fundamental within the food chain. In addition, studies were designed to detect possible subtle habitat disturbance factors influencing microtine rodents.

THE COMMISSIONER: Excuse me Dr. Jakimchuk. What does microtine mean?

A Essentially it is a classification that refers to mice and voles, voles being mice with very short tails generally.

THE COMMISSIONER: Yes.

WITNESS JAKIMCHUK: The latter studies stressed the ecological significance of the group rather than concern for individual populations of microtines. In general, the level of generalization of studies carried out reflects the ecological sensitivity of the species or their social, economic or aesthetic

importance.

The first major study initiated concerned the Porcupine Caribou herd, commencing in March, 1971. This is the largest herd in the western Arctic of Canada, and is an important resource from an ecological standpoint since caribou are one of the dominant herbivores in the Arctic ecosystem. In addition, caribou are an important resource to native peoples and aesthetically important because of their large numbers. Furthermore, the Porcupine herd ranges over very wide areas and could come in contact with potential industrial development.

Our initial objectives in studying the Porcupine Caribou herd were to obtain information on the population dynamics, seasonal distribution and movement patterns, and behaviour; especially in relation to man-induced disturbances. The ultimate goal was to assess the nature, duration and significance of potential impacts. In addition, studies were designed to enable recommendations with regard to location, scheduling, design and operation and maintenance of the pipeline in order to avoid or minimize potential impact.

We set out to establish sufficient information about the populations so that we could assess if there were potential conflicts with the pipeline; and if that were the case, to determine the importance of the conflict and how it could be resolved. We assumed there was going to be an interaction, however we did not know the parameters of that interaction until we had sufficient baseline information on the caribou population.

Our studies have been one of the most intensive studies of caribou distribution ever carried out.

I would just like to now read very briefly some of the titles, short forms of titles of reports that appear in the Biological Report series on our mammal studies which will indicate the range of studies carried out.

On caribou we have a study of the Porcupine caribou herd in 1971. Distribution of movements of the Porcupine caribou herd in the Yukon, 1972. Distribution of movements of the Porcupine caribou herd in North-eastern Alaska, 1972. Distribution of movements of the herd in the Yukon, 1973. The same in north-eastern Alaska, 1974. Distribution and movements of the Porcupine herd in north-eastern Alaska and the Yukon Territory, 1974. And a report on the Kutchin caribou fences of north-eastern Alaska and the Northern Yukon Territory.

On other ungulate species we have reports on distribution of moose, muskox, and sheep

in north-eastern Alaska; observations of moose in the Northern Yukon Territory and Mackenzie River Valley; distribution of Dall sheep in the Mount Goodenough area, Northwest Territories; moose in mammal studies in north-eastern Alaska with emphasis within the Canning River drainage; Dall sheep in the foregoing report; population surveys of ungulates in a report on surveys of mammals along the proposed gas pipeline in Alberta; distribution and numbers of muskoxen in North-eastern Alaska and the Northern Yukon, 1973.

On furbearers and small mammals we have a study of furbearing mammals associated with gas pipeline routes in Alaska; a study of furbearers associated with proposed pipeline routes in the Yukon Territory and Mackenzie River Valley, 1971; Arctic fox on North Slope of the Yukon Territory, 1972; Beaver studies in the Mackenzie Valley, 1972; a study of marten in the Mackenzie District, Northwest Territories; muskrat studies on Old Crow Flats in the Yukon Territory, 1972; wolf, wolverine and red fox within an overall report on mammal studies in North-eastern Alaska; population surveys of small mammals in surveys of mammals along the proposed gas pipeline in Alberta; population surveys of terrestrial furbearers in that latter report as well; population surveys of beaver in the Alberta volume; a study of the ecology of small mammals near Chick Lake that has been carried out in 1972, 3 and 4; a study of furbearers with particular reference to marten at Chick Lake, 1974.

On large carnivores -- and I will point out right now that in one of these reports we presented data on moose, which is not a large carnivore, it's an ungulate, so bear that in mind. Under this heading, however, we have observations of moose, wolf and grizzly bear in the Northern Yukon Territory, '72 and '73; observations of grizzly bear in the Northern Yukon Territory and Mackenzie River Valley, '72; grizzly bear in mammal studies in North-eastern Alaska with emphasis within the Canning River drainage; the home range and population dynamics of grizzly bears in the eastern Brooks Range, 1974; Environmental considerations for the polar bears of the Beaufort Sea, 1974; Removal of radio-collars from grizzly bears in the eastern Brooks Range, 1975; polar bear den survey, 1975; home range and population dynamics of grizzly bears in the eastern Brooks Range, 1975.

In addition to these studies I've described, we have carried out a number of disturbance studies. These are what I previously referred to as the experimental or problem-solving type studies. These include:

1. A study of the reaction of caribou and Dall sheep to the simulated sound of a compressor station .
2. A study of the response of caribou to cutlines encountered during winter and spring migration.
3. A study of the reaction of caribou, moose and grizzly bear to aircraft disturbance.
4. Reactions of caribou to man-made objects.

5. A study on the effects of seismic lines on small mammal populations near Fort Simpson, Northwest Territories.

6. The reaction of barren ground caribou to aircraft in a report on the reaction of some mammals to aircraft and compressor station noise disturbance.

7. The effects of simulated compressor station sound on Dall sheep using mineral licks in the Brooks Range, Alaska.

8. And finally, the reaction of Dall sheep to an FH-1100 helicopter in that latter report.

The scope and range of studies conducted is documented in the preceding list. It is my opinion that these studies have formed an adequate basis for assessing the proposed development, probable impacts, and establishing mitigative measures.

It is noteworthy that studies reflect a wide range of ecological investigation. These range from fundamental baseline studies, studies of disturbance to minor species important as converters within the food chain; studies of behavioural characteristics and experimental disturbance studies. Attention has been devoted to species such as marten and beaver as well as the more visible and glamorous species such as Dall sheep and caribou. This is consistent with our goal to investigate the widest possible range of impact of the pipeline on mammals.

As a consequence, it is my opinion that the studies undertaken are both adequate, and address with specific data the concerns that have

been raised before this Inquiry and that they have met the requirements of the applicable N.E.B. regulations and that insofar as my discipline is concerned, the pipeline can be built within the requirements of the DINAD Northern Pipeline Guidelines.

Our impact assessment is based upon the present proposal, design, and assumptions that revegetation will proceed as described by Mr.Dabbs.

Environmental input. We formally commenced working on routing recommendations starting in early 1972 with systematic review of alignment sheets. Prior to that recommendations were made in reports or informally, such as through phone calls.

A procedure was established whereby Renewable Resources regularly received for comment copies of alignment sheets and drafts of the exhibits dealing with construction procedures.

We also participated in meetings and discussions with the engineers, including that held during the week of April 9th to 13th, 1973, should be added there.

Our fundamental recommendation was for a coastal route in Alaska and the Northern Yukon. This recommendation was based primarily on avoidance of interactions with the caribou population, and other species such as Dall sheep. It is also based on avoiding habitats of furbearing species which were considered to be of greater significance on the interior route than the coastal route. Our recommendation was based upon the assumption that construction would be

during the period of migration and when the largest portion of the herd is on the winter range to the south.

There appears to be an error there. Yes, there is an omission, a typewritten omission. I repeat, our recommendation was based upon the assumption that construction would be completed by the time of migration, and would take place when the largest portion of the herd is on the winter range to the south.

As far as caribou are concerned,winter construction on the coastal route would preclude interactions during the migration period and the calving period. The coastal route does go through the calving grounds, however pipeline construction is scheduled for completion prior to the time calving or migration would take place. There is a greater possibility for an interaction on the interior route with caribou. Most of the population, for example, winters south of either of the pipeline routes but the wintering range is closer to the interior route.

The interior route also is closer to Old Crow Flats, an ecologically important area. A further reason for not recommending the interior route is that it travels through the Canning River Valley in Alaska which is perhaps the most productive wildlife area along the entire routing in Northern Canada and Alaska.

The coastal area is used for foraging by grizzlies during the summer period. However one of the advantages of the coastal route is that during winter construction most of the bears would be inland in dens, so that there would not be a direct interaction during the construction time. During compressor station construction in the summer, interactions could occur with the bears being attracted to an area of human activity.

Interaction with the most important Arctic fox denning habitat is avoided on the coastal route. During winter construction the only other mammal interactions may include small numbers of caribou which are sometimes found on the coastal plain and a population of muskox in Alaska consisting of 30 to 40 animals in total. There would be interaction of negligible significance on small mammals, such as microtine rodents, but these would be unavoidable in any pipeline routing. I should point out also that the prime route as it swings south along the west side of the Mackenzie Delta passes within one mile of a Dall sheep range in the vicinity of Mount Goodenough. This

was raised by the Pipeline Application Assessment Group. I feel that during construction activities some displacement of sheep may occur from the extremities of range nearest the pipeline. It is, however, unknown and impossible to predict if this will be the case and how many animals might be affected. My opinion isthat only a minor segment of the population might be affected. I do not think there is a likelihood of a mass exodus from winter range. Factors which lead me to this opinion are:

1. While the map distance to the edge of the range to the route is approximately one mile, there are buffers such as wooded slopes and steep topography between the construction area and the winter range. Sheep occupy the higher elevations during winter. Associated slopes at higher elevations,draws and plateaus also provide both a visual and noise buffer between the wintering sheep and the pipeline.

2. Existing and past hunting practices involve pursuit of sheep by snow machines. This pursuit is directed specifically at the sheep and results in direct mortality. I consider this type of activity more disturbing than a passive noise disturbance. The fact that sheep still occupy the winter range indicates that they have either habituated to disturbance to some degree or have altered their winter range prior to any existing studies.

If faced with a choice of potential construction disturbance, I would favor avoiding the lambing period, during May to mid-June.

Present scheduling of construction would avoid this period.

I would add that I agree with the Assessment Group's suggestion that construction on the segment of the line near the winter range take place in early rather than late winter as an additional precaution.

Q Mr. Jakimchuk, just before leaving this point, I realize we'll get into this later but I wonder if you just might comment about the effect the cross-delta route would have inso-far as the Dall sheep near Mt. Goodenough are concerned?

A Well, with the cross-delta routing, as a matter of fact that whole section becomes quite redundant because it by-passes that sheep population by 40 or more miles and that then becomes -- there is no longer any concern of even a peripheral interaction.

Q Thank you.

A Potential interactions with caribou. The calving period is from late May through mid-June. Winter construction activities in the calving area will be completed by May 1st, therefore there will be no direct interaction with the calving herd because of the construction schedule. Summer construction is proposed for compressor stations however strict measures are designated in the application to avoid aircraft overflights, vehicular interference, and other construction activities within

the calving ground during the calving period.

Strict protection should be given the calving herd at this time in addition to measures to avoid interference with the movements of the post-calving aggregations.

From the intensive studies of the Porcupine herd over the last four years we have established that there is a general consistency in their annual cycle. This does not mean, however, that the population is precisely predictable. Variations have occurred in movement patterns, distribution and timing of movem ents in response to natural environmental conditions. The type of environmental changes I refer to are such factors as snow depth, temperature conditions, time of spring breakup on rivers which are crossed in migration and existing human activities within the range of the herd.

We have also documented variations in the extent of the calving ground. However, the variations which have occurred have not impaired the productivity of the population. This indicates that the caribou are able to adapt to environmental changes and conditions and still maintain their basic cycle and productivity.

Routing recommendations.

In 1972 we were asked our opinion on routing on the east or west side of the Mackenzie River Valley.

It was difficult to ascertain which would be better from the standpoint of mammals, however, we tended to favor the east side rather than

the west because we have documented important habitat particularly for aquatic furbearers on the west side. Two such major areas were the Ontaratue and Ramparts River Deltas on the west side of the river.

We also proposed a major change in the vicinity of Travaillant Lake during our 1973 review meetings. This is with respect to what was then known as the Richards Island lateral. The alignment as it existed, went through an area important for trapping and for the production of furbearing mammals and birds. As a result, there was a major change made in the routing to avoid what was considered to be an environmentally sensitive area.

We have also examined the Fort Simpson realignment during 1974 and 1975. We feel that this realignment is not materially different than the original routing, and is an acceptable routing with respect to mammals.

From our first year of involvement in the project we made recommendations to avoid sensitive or critical areas and during the April '73 review meeting numerous minor alignment changes were recommended, many of which were implemented.

Scheduling. Scheduling of construction is a vital consideration in avoiding conflicts with mammals; particularly caribou. We have made numerous recommendations on scheduling. Some of them have been very specific in that they refer to particular mountain passes. Other scheduling recommendations are general, and referred to acceptable

construction periods within a geographic area. The decision to carry out winter construction which was made for both engineering and environmen tal reasons, has the result of avoiding many interactions between construction activities and mammals. These recommendatons have been re-evaluated and refined as additional data from our research was obtained each year.

Other recommendations. From an early stage in our research we raised concerns regarding alteration of the downslope hydrological regime in permafrost areas. This was a general environmental concern related to possible effects on habitat. We discussed this several times with the engineers and hydrologists. The current design for ditch blocks to avoid ponding along the line and a granular crown in potential problem drainage areas is, in part, I feel, a response to the concerns we raised early in our studies.

We have made specific recommendations for most species, whether or not they are considered rare and endangered. This is because there is a variance between what is considered rare and endangered according to the source. We feel, however, the protective measures should apply irrespective of the official status of mammal species and have made recommendations accordingly.

For example, we have made specific recommendations to avoid any physical alterations of den sites for Arctic fox and grizzly bear. We have set altitudinal guidelines to avoid aircraft harassment

of caribou, barren ground grizzly bears, moose and Dall sheep. We have recommended operational and policy procedures to avoid killing of animals through shooting or trapping. This is particularly important in the case of bears since conflicts between man and bears often result in unnecessary destruction of bears. We have recommended fencing of compressor station sites and airstrips at strategic locations to avoid conflicts with caribou and grizzly bears.

The recommendations made appear in the environmental exhibits as policy and in segments of the design, operational and construction exhibits.

Specific recommendations to avoid aircraft harassment and other disturbances to mammals based on limits established by our research appear in the application as protective measures to be followed by the Applicant.

In conclusion, it is my opinion that the pipeline as proposed will not have major adverse impacts on mammal populations and that the impacts anticipated will be local and minor.

MR. MARSHALL: Sir, Mr. Jakimchuk also has some slides that he wishes to present and in addition, the paper that was distributed the other day. And I will ask Mr. Jakimchuk to present these slides. Do you wish to do these slides now?

A Well, I actually I should probably read this and then show the slides.

THE COMMISSIONER: Fine. Whatever you think, sir. Do you have a copy, sir.

A Yes.

First, a word of explanation. I have been following the proceedings with a great deal of interest and the testimony of other witnesses and as a result of that, I have prepared an analysis related specifically to the Porcupine Caribou herd.

THE COMMISSIONER: When you say

you have followed the evidence of the witnesses, we had the evidence of Dr. McTaggert-Cowan and we saw the evidence of Dr. Banfield, Dr. Geist and perhaps Dr. Weedon as well touched on the herd.

A That's correct.

Q Is there anybody else?

A Not specifically that I can think of.

The purpose of this in as much as I have arrive at some conclusions and recommendations, I think the primary purpose of this presentation is to put forward the process by which I arrived at these. The rationale for reaching the conclusions.

I regret if some of it may seem redundant to what I said previously but I will go through this and follow it up with some slides.

Q All right.

A A great deal of attention and concern has been focused on the Porcupine Caribou herd in the regulatory process regarding the proposed Arctic Gas pipeline. This is both understandable and proper because of the importance of this resource, economically, ecologically, and aesthetically in the United States and Canada.

Underlying the general concern and articulation of possible impacts are two questions:

1. What is the likely

impact and where are the dangers?

2. Which routing is more (or less) desirable or prudent from the point of view of the caribou population?

Testimonies presented to date intimate a serious impact on the herd. Testimonies referring to extirpation of caribou in the Mackenzie Balley by Dr. Cowan inferred that extirpation may be a consequence of pipeline development, although depletion was the stated prediction for the Porcupine herd.

However, in testimonies to date, no clear preference has been advanced for a routing with respect to caribou. The government assessment report has indicated, however, a clear preference for the interior route with respect to mammals -- considering the Canadian environment only.

In this presentation, I would like to address the question of impacts on caribou, then the question of the coastal versus the interior route with respect to the Porcupine herd.

Very detailed information has been obtained on the distribution and movements of the herd over the past four years. (For further information, refer to Volumes 4, 7, 22, and 32 of the Biological Report Series.)

In addition, disturbance studies have provided quantitative data on responses to various types of disturbance during the regulatory process. (Volumes 5 and 23 of the Report Series.)

Most concern has been focused on:

1. Disturbance initiated mortality.

2. Interruption of migrations (the barrier potential).

3. Interference with calving and post-calving activities.

Loss of habitat has not been considered as a serious concern because the 120 ft. right-of-way represents a minute habitat loss when the 100,000 square miles of range of the herd is considered.

The areas of concern mentioned have been researched from 1971 to the present and the results have been presented in the Biological Report Series. It has been generally acknowledged by those who have reviewed our reports that the Applicant has done detailed work on distribution and movements. However, the experimental studies conducted have received little mention. These studies indicate a very early effort to test, in the field, many of the hypotheses and concerns of the consultants, concerns which have subsequently been articulated at these hearings. I emphasize that the experimental field studies carried out were both innovative and pioneer studies in testing possible impact factors ranging from deflection of caribou from a cleared right-of-way to the effects of compressor station noise in calving areas. Of all the agencies involved in assessing this project, only the Applicant has conducted experimental

studies, not only on caribou but on other species as well. This is of paramount importance, since these studies provide a scientific basis on which to assess concerns and refine the speculative hypothesis into a probability analysis.

The Applicant's studies have done more than just define distribution and abundance -- the primary phase common to most wildlife investigations. In the course of studies, biological characteristics and behavioural attributes have been dealt with. Thus, one can frame a conceptual scenario in concert with other literature against actual data, rather than a conceptual scenario against theory alone.

This is the singular attribute of the Applicant's studies which gives credence to the conclusions drawn and provides a data base for the conclusions.

Some interesting findings of the studies provide examples of the range of subject considered. For example:

1. Over a four-year period, the peak of calving has been between June 5 and 7 -- a remarkable consistency.

2. The post-calving aggregation -- the coming together of the whole herd -- has occurred within a 10 day period over four years.

3. The re-entry into Canada on post-calving movements has occurred within the same general routes and time frame over a 4 year period.

4. Caribou encountering a cleared seismic line or winter road will not be deflected if the angle of approach is greater than 45°.

5. Winter roads with prior vehicular travel are preferentially utilized by caribou.

6. Caribou fences (of aboriginal origin) along summer movement routes provide evidence of long-term tradition in the movement cycle.

7. Snow barriers can create differential spring migration timing in the northern Yukon.

In order to define the critical elements to the survival of caribou, one has to look at their behavioural adaptations within their lifetime (which is referred to as ontogenic attributes) and in the evolutionary timeframe (where they are phylogenic development).

Many adaptations are readily apparent, while others are more obscure. However, the range of adaptations include behavioural, morphological and physiological factors.

Thus, we can readily determine that migration, herding, dispersals and calving are adaptations which in some way have evolved to enable survival in a harsh environment. These are traditional and phylogenic in origin. Structural adaptations enable caribou to survive and prosper in

a particular set of environmental circumstances. Examples are: Hooves adapted for travel over soft terrains, and for cratering in snow -- the adaptation to a predominantly nival existence. Hollow pelage provides both efficient insulation from cold and buoyancy for the frequent swimming done in the course of annual movements.

Physiological adaptations enable caribou to withstand extreme cold, and to ingest an extremely wide range of forage -- changing drastically with the seasons.

Behavioral adaptations include responses to predators, insect harassment, and to physical environmental conditions. These, also are numerous and extremely varied. In essence, however one can conclude that behavioral adaptation is a mechanism which places the animals, or the species in the most favorable position for survival at a given time or under a given circumstance.

Thus, while caribou are closely tied to a calving range, their utilization of winter range is move variable, depending on snow conditions. They display, within an overall traditional behavior, sufficient elasticity in their behavior to overcome most short-term environmental contingencies such as: unfavorable snow conditions on winter range, natural barriers such as rivers and mountain ranges, extreme cold and response to danger. The almost constant movement of caribou throughout this annual cycle pre-

cludes over-utilization of range, where the growth rates of forage are slow and productivity per unit area is low.

When one examines all of these factors we find that caribou have certain attributes which enable them to survive. What then are the weakest points in this chain of survival? What is the most tangible manifestation of a caribou meeting its need for survival? One answer is the migration and mobility of the species. Another is their reproductive potential, that is, the ability to overcome mortality from hunting, death by natural causes and predation. Another is their ability not only to bear young but to have the young survive to maturity. Which of these factors is the over-riding consideration in terms of human disturbance, and more particularly in terms of the pipeline proposal?

Let us now look more specifically at some of the key elements of the life cycle concerning the Porcupine caribou herd.

And I'd just add in here that I have tried to make this very brief in terms of the life cycle elements. So you may have some further questions on them.

Migration -- The major purposes for the long annual migrations of caribou are as follows:

(1) It enables them to utilize range most effectively without over-utilization.

(2) It places them in the most favorable energy balance potential at various times of the year.

(3) It enables them to bear and rear young on the most favorable habitat.

CALVING

The calving grounds of the Porcupine caribou herd have many attributes. They are snow free earlier than other portions of the range. Uplands are drier. The major forage for cows at this time, Eriophorum (cotton grass), is abundant and available. It is highly nutritious and provides vital energy for demands of lactation following calving and a return to vigor following the spring migration.

Calving grounds are generally remote from major predators. The widespread distribution of the calving population, over several thousand square miles, favors survival of calves and spreads the risk of localized disasters such as storms or concentrations of predators.

THE COMMISSIONER: Just pausing there. The calving population would be distributed along the coast from somewhere in the vicinity of the Beaufort Sea to west of the international boundary.

A That's correct. I have a couple of overhead slides which will show the distribution over the past four years, but generally one could consider the calving grounds from the Babbage River west to the Canning River in Alaska. In some years the bulk of the population may calf in Alaska. In other years, portions calf on the Yukon side.

THE POST CALVING AGGREGATION

Its purpose is unclear but it may serve to bring the whole herd together in

maintenance of the herd traditions, maybe the stimulus for summer movements, protection from insect harassment or even to ensure genetic mixing of the herd components. The aggregation is the only time of the year the entire population interacts as a single unit.

SUMMER MOVEMENTS

At this time, the herd moves as a single unit, then splits up and follows a traditional path over summer range. The destructive capabilities of tens of thousands of animals on the terrain is readily seen at this time. These movements are characterized by large groups eventually splitting into smaller and smaller groups. Summer movements appear to function as a way of distributing caribou evenly over the summer range, and as a mechanism to avoid insect harassment.

THE AUGUST DISPERSAL

No longer are the large herds present but caribou are dotted over the landscape of many thousands of square miles. They are more widely dispersed than at any time of the year. This is a vital time also since gains in weight and storage of fat provide energy for the migration and the forthcoming winter.

Animals which are thin and rangy in June and July are sleek and fat by the end of August, a remarkable transition. Thus, the dispersal is also a vital mechanism which distributes grazing pressure and precludes competition of available forage

resulting in the fastest possible accumulation of fat and long-term maintenance of the range.

THE FALL MIGRATION

Once again larger and larger aggregations form which eventually culminate in a directed movement to winter range, often triggered by a severe storm. Breeding may take place during or immediately following the migration, depending on its chronology in a particular year.

WINTER RANGE

Here caribou maintain themselves during the long, dark winter. They are loosely aggregated and constantly making random movements within the vast area of winter range seeking out lichens and soft, shallow snow cover in the taiga where craters may be dug with a minimum of energy expenditure. Areas are sought where movement is unimpeded either by deep snow or crusted conditions such as are found in untreed windswept areas. When extrinsic environmental conditions are favorable, caribou again display elasticity in behavior. Examples are, wintering on portions of the North Slope and the Old Crow Flats during winters of minimal snowfall. And as you will see from slides overhead later, there has been some wintering in the northern areas in the last two years, including the Slope.

MR. MARSHALL: Just on that point, approximately what numbers would be involved?

A Last year, I believe, it

was approximately 5,000 out of the herd of 110 to 115 thousand, the year before last. And last year it could have been up to 10% of the herd, up to 10%.

THE COMMISSIONER: Wintering on the coast?

A Yes. Throughout this annual cycle, calves which survive to yearlings are replacements to the herd and, depending on this survival rate, the herd will decrease, remain relatively static, or increase in total numbers. It is characteristic of caribou populations that recruitment to the herd is generally low. This may be generally attributed to the high calf mortality owing to predation and accidents. Adult caribou are also lost to the herd by predation, accidents, hunting and old age. Caribou generally do not experience explosive growth rates because of these factors.

One then can consider an impact to be major if factors operate to reduce the herd beyond its level to replenish itself with the annual increment necessary to maintain the population. That is, any mortality or a change in productivity, direct or induced which exceeds the reproductive capability of the herd. This then would be the measure of impact and the distinction between a severe, major impact and a minor impact.

In an impact analysis, therefore factors should be examined which could change the total recruitment to the herd.

These factors are:

- Depletion of range.
- Direct killing by hunting, vehicles.
- Harassment.
- Interruption of traditional behavior with secondary effects leading to mortality.
- Interference with productivity (calving or calf survival).

Of all the factors presented and considering the elements of the annual cycle, the ramifications of pipeline routing, construction and operation should now be considered:

- Removal of range directly by a right-of-way is considered insignificant by all assessments made.
- Direct killing is a function of access but a controllable variable through regulation. The access provided by a pipeline right-of-way is variable and seasonal, but to a large extent a controllable factor, for example, sport hunting would not occur during summer and airstrip utilization during winter could be controlled. The lack of a permanent road is a significant mitigating factor with respect to access.
- Killing by collisions with vehicles during winter construction on the coastal route is unlikely.

At the most a small percentage of the herd have been recorded wintering in this area. Wintering may not occur at all in this area, since the usual winter range is the forested taiga.

During the winter animals are generally dispersed, they are non-migratory at this time. Vehicular travel will not be high-speed and avoidance of collision is possible by the actions of both the vehicle operator and evasion by the caribou themselves.

HARASSMENT

This subject has been well discussed in depth during the regulatory proceedings. Specific protective guidelines based on research data have been established by Renewable Resources for the applicant. For example, measures will be employed to avoid activity in the calving ground entirely during the calving period.

INTERRUPTION OF TRADITIONAL BEHAVIOR

Studies of the Porcupine herd, other caribou herds and a conceptual analysis of caribou evolutionary adaptations lead to the conclusion that migratory movements are vital adaptations to the maintenance and survival of caribou. They allow caribou to exist, reproduce and perpetuate within rigorous climatic constraints and in habitat of low general productivity. Interruption of migrations has direct and indirect implications, many of which may be unforeseen. These include the spring and fall migrations and summer movements and utilization of calving range.

Historically, records show a high mortality of calves where migration to the calving grounds has been impeded and blocked by deep snow. Other implications are possible changes in patterns of range

use, both summer and winter, and changes in synchrony of movements all of which have the potential for major effects on productivity during the longer term if evolutionary traditions are altered. That is, a short-term change in patterns would preclude learning processes of calves and yearlings thus progressively altering traditional patterns.

Therefore, I have concluded that the migratory periods are the most vital elements in the life cycle of barren ground caribou, the weakest link in the chain. The spring migration includes pregnant cows who must reach calving grounds to successfully calve and meet vital nutritional requirements. The summer movements appear to be important in range utilization and energy buildup. The fall migrations lead caribou to winter range and shelter requirements. The post-calving aggregation is undoubtedly an extremely important event though its function is not full understood.

INTERFERENCE WITH PRODUCTIVITY

Calving and post-calving periods are very important and the characteristics of calving have been previously described. It occurs over an approximately 4,000 square mile area, with the density of the calving herd becoming progressively greater following the peak of calving to the formation of the post-calving aggregation.

Strict avoidance of disturbance during and following calving is a necessary precaution

despite the fact that disturbances such as aircraft would only involve a small portion of the calving population at any given location. It is important to note that the calving herd is not in fact a herd but a loosely distributed continuum, so that a disturbing factor would not affect the entire herd as a unit.

Since winter construction will preclude an interaction with calving, what will be the effect of a coastal routing across the calving ground?

The calving ground is the terminus of the spring migration, and of all movements, the arrival of caribou in the area is the most predictable and consistent event in their movement cycle.

It should also be mentioned that the main segment of the calving area occurs south of the coastal actual routing, but the entire area to the coast of the Beaufort Sea may be considered a potential calving area.

The effect of a buried pipeline built in the area in winter would be a low mound of spoil material along a disturbed right-of-way. No activity would be under way during the calving period. The right-of-way would not form an impediment to movement and in any event, as Dr. Cowan has noted in his testimony, most migratory movement on the coast prior to calving is parallel to the right-of-way.

In time, caribou would encounter compressor stations. However, studies undertaken by Renewable Resources for the applicant have ascertained that the noise is an insignificant disturbance to caribou and does not affect their behaviour or movements. Dr. Geist has referred to the well-known principle of ungulate adaptation to disturbances which are continuous and not associated with a harmful experience. At spacings of approximately 50 miles, stations are not expected to have either short or long-

term detrimental effects. Thus calving would proceed uninterrupted by construction activity, or aircraft flights. During the post-calving period any activity would be limited to the compressor sites and regulations regarding harassment of caribou would be in force.

We now know enough of the location of the post-calving aggregation, the period of its occurrence (July 3 to July 10, in general, I would add there, we have just recently recorded some variation there) and its duration, three to four days to prohibit any potentially disturbing activity at that time in that area.

By July 10th to 20th most of the Porcupine herd have left the North Slope and are south of the sphere of influence of the pipeline.

In the case of the Porcupine herd, elasticity in the calving area has been documented indicating an adaptive capability to respond to environmental conditions. For example, rivers in flood present crossing barriers to cows with calves, and are not crossed until waters drop or calves are sufficiently strong to negotiate the crossings.

Population declines. Declines have been most often postulated as a result of hunting and predation, and by some workers, caribou researchers, loss of range to forest fire -- but that is a subject of debate within the literature. The only declines attributed to human developments relate to interferences with migratory movements. Vehicular movement on highways and railroads in particular serve as barriers

to movement, and as a source of hunting mortality provided by access. The decline of the Nelchina herd in Alaska is a case in point.

THE COMMISSIONER: That isn't the 40-mile herd?

A No, it's a different herd. Dr. Klein of the University of Alaska has written a paper on the effects of human development on reindeer in Scandanavia and in each case the interruption of the migratory movement is the factor involved in the decline or disruption of caribou behaviour.

Thus from the preceding analysis and the literature, I feel very confident in concluding that the pre-eminent and most vulnerable element of the life cycle consists of the migratory movements and their associated behaviour . In summary, I would like to quote from a 1971 paper by Dr. Bergerud, the paper has been published in the publication,

"The role of the environment in the aggregation movement and disturbance of caribou,"

delivered at a symposium in Calgary. I think Dr. Bergerud has some very interesting things to say so I'll read this verbatim, quoting:

"The seriousness of human disturbance should be considered in the light of the perceptive and escape adaptations caribou have evolved in association with wolves. For example, a road or a building are not factors that have been prior phylogenic contingencies. Caribou have

no adversion to roads or railroads in Newfoundland. These are just more open tundra to travel upon. Animals in Newfoundland even detour to be able to walk along roads. Further, the noise of a car is cause for only a temporary alert. However, the motion of a vehicle is a stimulus for flight. A road could be a barrier if the vehicle activity is such that strange moving objects are perceiv ed continuously. Many caribou in Newfoundland cross the Trans-Canada Highway in the early morning hours prior to traffic. Airplanes again provide motion; the helicopter more so than fixed wing. Again caribou pay little heed to high flying planes when the noise is heard but the motion is not perceived.

Caribou are tolerant of civilization. The Avalon herd in Newfoundland uses ranges within one mile of a well-travelled highway. The Humber herd winters on ranges where cars and trains are heard daily. Caribou in Gaspe Peninsula, Quebec, feed in the winter on arboreal lichens on trees recently cut by loggers. The behaviour of barren ground caribou crossing roads and railroads and even passing through communities is well-documented.

The use by caribou of open habitats plus their gregarious herd structure and inability to perceive motionless objects makes them extremely vulnerable to hunting. Caribou probably often do

not live near man because adjacent populations have been over-exploited. Phylogenically there appears little adversion to man - caribou can live near man if we permit it.

Caribou are wilderness animals in one sense; large herds need vast areas to wander in. The gregarious herd structure superimposed on the slow-growing fragile Arctic flora requires continuous wandering. This continual movement of caribou is perhaps their major adaptation to their extrinsic environment.

In summary,"

this is Dr. Bergerud again --

"...I suggest that the open habitat-wolf-caribou interaction has phylogenic consequences not liable to rapid modification. We might expect caribou to continue to be unwary towards man, gregarious and vulnerable to hunting as long as wolves are part of their environment and breeding populations are large. In situations in which food, insects or weather are important considerations in behaviour a plastic response might be expected. We might expect adaptive modification to human activities that affect these latter components of the natural environment of caribou."

To conclude, I would like to discuss finally routing considerations. The foregoing discussion provides the basis for assessing route preferences with respect to caribou. Other species and

their habitats are also considerations from a mammalogical standpoint, however this comparison is based on caribou alone.

For the sake of brevity and in view of the preceding discussion, a point form comparison will be made of advantages and disadvantages of both routings. I'm talking now about the coastal versus the interior route. It is stressed that Alaska portions of the caribou range are included since these habitats are just as important as those in the Yukon to the welfare of the herd.

O.K., we'll look at the coastal route. Advantages:

1. Avoids major migratory movem ents.

2. Construction completed one month prior to arrival of caribou for calving.

3. Fall migration out of the area precedes winter construction by one to two months. We have to revise that comment to some degree to account for a small herd component that winters there.

4. Summer movements are south of the routing, generally south of the routing.

5. It avoids main winter ranges by 100 to 150 miles.

6. Is remote from existing hunting villages, except for Kaktovik in Alaska.

7. The construction schedule avoids the post-calving aggregation.

Those are the advantages I view of the coastal route.

The disadvantages are:

1. The routing crosses the calving ground.

2. There will be compressor stations within the calving ground.

3. The post-calving aggregation occurs on the coast where there will be some summer activity.

4. Portions of the herd have been known to winter within portions of the coastal alignment.

The interior route has the following advantages:

1. It avoids the calving ground.

2. And it avoids the post-calving aggregation.

In terms of the disadvantages, the list I feel is much longer. The disadvantages of the interior route are:

1. It crosses the migratory paths of spring and fall migrations and summer movements.

2. Year-round activity in the Canning River Valley in Alaska would interfere with movements during spring, fall and summer. I'm talking about year-round construction activity in that area.

3. The routing crosses a major winter range in Alaska.

4. It crosses winter range in the Richardson Mountains.

5. It is within the northern periphery of a major central Yukon winter range.

6. Access provided within the Canning Valley and within Alaska and within winter range for hunting. I'm referring now to the substantial amount of rock work that will be required-- would be required in that area that would actually provide permanent access roads, as opposed to a buried pipeline through soil.

7. Migratory movements on the Richardson migration route, that's through the Richardson Mountains, occurred as early as March when winter construction would still be under way.

8. The Old Crow migration is avoided by a variable of only zero to two weeks within the proposed construction period.

9. Compressor stations would be located in migratory corridors.

10. And also, compressor stations and other facilities are often in confined areas, for example, river valleys.

Now, I have not given any particular weight to those advantages and disadvantages. I want to point them out to you as my rationale.

The foregoing are not weighted according to possible mitigative measures or major changes in construction scheduling. My conclusion, however is preference for the coastal route in terms of the overall considerations presented, the construction plan, mitigative measures proposed and margin of avoiding interaction by construction scheduling. The latter point combined with unavoidable interference with caribou via the interior Canning River route are the most compelling reasons for these conclusions. Access is also a more significant factor on the interior route.

In summary my preference is based upon considerations of details of the ecology of the ecology of the Porcupine caribou herd and factors which may influence their productivity and population status in particular, the evolutionary importance of their traditional behavior and ramifications of the pipeline on these, and their adaptive potential. Potential secondary effects such as hunting provided by access and examples of caribou declines discussed in the literature where human development activity has been cited are also important factors in my conclusion.

I have also concluded that the pipeline, as proposed, will not impair the status

and I stress that "as proposed" -- will not impair the status of the caribou population. This development in itself will not exceed my major impact criterion: That is the ability of the herd to replace potential losses by its annual recruitment. It is in fact, my expectation, that actual losses or effects attributable to the pipeline both short- and long-term will be negligible.

That concludes my fairly lengthy analysis of the routing considerations and impacts. I felt it was necessary to do so to give my rationale.

THE COMMISSIONER: Yes. Thank you, Mr. Jakimchuk. I think that since no one is here today from the Environment Protection Board and since during Phase Three, Dr. McTaggart-Cowan is, as I understand, to be cross-examined, you should arrange, Mr. Goudge for Mr. Jakimchuk's paper to be sent to Dr. McTaggart-Cowan so that he can read it before he is cross-examined which I take it will be some time in December.

Now, just before you show the slides. You have made it plain that the principle concern you have in relation to pipeline construction would be if it were to interfere with migration.

A That's correct.

Q You say that you're satisfied that the coastal route, the prime route would not seriously interfere with migration and you

say that in the very last sentence of your paper that it is your expectation that actual losses or effects attributable to the pipeline both short- and long-term will be negligible. Is that your opinion if the pipeline were to follow the interior route? Or does that remark -- does that opinion apply only to the coastal route?

A With respect to the interior route, I think there would be some unavoidable interactions that take place that we cannot really percieve. The degree of unpredictability is greater there. I would not feel as confident in making that type of a statement for the interior route but I should also add, sir, that much of my concern for the interior route relates to other species apart from caribou.

Q Other mammals?

A Other mammals as well as caribou and I cite specifically portions of the interior route in Alaska. So from a mammal standpoint, overall, I do not favour the interior route. I think it would be more damaging from an overall mammal standpoint than a coastal routing and I stand by my conclusion with respect to the coastal routing for most species.

Q Well thanks.

MR. MARSHALL: Q Mr. Jakimchuk, did you want to make your slide presentation from here.

A Yes.

I will very quickly go through these, Mr. Commissioner. You have seen some of them before during the over-view hearing. They will give you a graphic view of some of the things I have been talking about.

This is the general range of the Porcupine herd. You will notice that it encompasses most of the northern Yukon and well into northeastern Alaska.

Here, this is a generalized diagram showing the yearly cycles and patterns I referred to. Wintering in the central Yukon another major wintering area, you will see where the red lines are off in Alaska, the east fork of the Chandalar and so on. Those are the two major wintering areas.

Spring migrations northward up the Richardson Mountains and via the Old Crow area.

MR. MARSHALL: Q Could you just go to the overhead and trace that out?

A Well, the problem is this is upside down. Okay, calving taking place along this segment of the coast. The basic yearly patterns that the caribou have followed over the last five years that we have studied them and from other evidence for a long time prior to that.

THE COMMISSIONER: I noticed you had the Alaskan Panhandle dipping into the Mackenzie Bay. We'll ignore that. There it is again.

Hemstock, Dabbs, McCart, Gunn,
Jakimchuk, Banfield--In Chief

A Here we have four years of information presented and color-coded. You can see the two major wintering areas that I refer to that we have documented. You will also see the intrusions that I have to point out in '73- '74, '72-'73, a segment of the herd that has wintered along the coastal plain as well as the northern Richardson Mountains.

I would expect that to be different this year because possibly if there is a greater snowfall but we will have to see. The general wintering areas in any event.

Here are details of the spring migration of the herd in '71-'72. The thickness of the lines indicate where the major movements are. The other lines indicate smaller numbers of animals.

You will notice when we superimpose -- I'm having a little trouble here -- when we superimpose '73 and '74, there are variations but the basic pattern is the same, with one exception. You will notice a large blue line in the Brooks Range there. That indicates a major movement that took place out of the Chandalar wintering area because in '73-'74 a large portion of the herd actually wintered in Alaska.

Now, I talked about the calving grounds and their variabilities that we have documented. You can see the area of the calving grounds that we have delineated and the variations that have occurred from year to year. In general from the

Babbage River to well the Canning River, the Katakturak River is the main western limit but there have been small components a little further west than that.

I talked about the dense post-calving aggregation that take place following calving, at which time the entire herd forms very dense herds, comes together prior to the initiation of their summer movement.

The location of these aggregations are within the areas delineated there. 1972 and 1973 from Barter Island to the middle of Camden Bay and a little further west in 1974. Also a little further west this last year.

Following that huge aggregation we get post-calving movements and the August dispersal. This time where they come back into Canada during approximately the tenth to the middle of July. They come back to the Richardson Mountains. The groups break up smaller and then they swing back into Alaska and they disperse so that during the August period they are just. They are very thinly distributed over many thousands of square miles.

This clockwise movement appears to be very traditional. I hate doing this but we overlay 1973 and 1974 data, we get virtually the identical types of movement. And one of our reports on caribou fences is quite interesting. It points out the correlation of the location of these fences with this summer movement cycle.

I don't think this one is very edifying. The fall migration, it's pretty hard to trace the arrows, but what essentially happened, the big brown arrow after the August dispersal, there is a gradual coalescing of the animals and a general movement south to the winter range. In some years, however, the animals turn back and winter in Alaska. That is essentially what that portrays.

This one for '73 and '74 , the same type of pattern, maybe a little simpler, and following that fall migration we have animals then on winter range and in some cases during the mid-October period, as occurred during '73 in particular, substantial movement westward into the drainage of the east fork of the Chandalar River for wintering.

O.K., that's the annual pattern. I'll just show a few slides that show caribou doing these things.

Mr. Commissioner, I should point out that these slides are strictly on caribou. I did just show a much greater representation of mammals and their habitat during the overview, but I'm focusing right now on caribou.

Here is what a typical winter range looks like that's been utilized for feeding, cratering that has taken place through the taiga area. This happens to be in the area south of Old Crow about 50 or 75 miles, and I mentioned about the fact that caribou are almost constantly mobile when they feed. You'll see when you get close these craters are not

next to each other where they tend to be dispersed across the landscape, but the grazing pressure in any one area is not usually very intense.

In the winter, in the late winter the groups tend to come together. You can see along to the left some of the taiga that is utilized as winter range, but we also have some mountaintops where temperature inversions create very favorable conditions for caribou so that they will gather there and they will do their feeding there. They will tend to aggregate in larger and larger groups until the spring migration is stimulated and then they start streaming along generally traditional corridors northward to the calving grounds. This particular group of mammals, this photo was taken in '71 on what we have termed the Old Crow route, the major migration corridor that passes through Old Crow.

In instances of deep snow single file travel is used, with the leaders spelling off. The snow is very deep and they wear quite a substantial channel or gully through it to make passage easier for the bulk of the herd. Even though caribou aren't directly observed migrating, their trails leave evidence of the routes they have taken, and gives an approximate idea of the numbers of animals that have passed. This is Schaefer Mountain, which I am sure you've seen north of Old Crow, where the trail is left by a spring migrating group of caribou.

I talked earlier about the obstacles that they face. Here we have a cow caribou

in terminal stages of pregnancy. They have yet to make such crossings as the Porcupine River after breakup, ice flows, sometimes they get crushed, they face swift currents as well as some pretty formidable physical obstacles. There is an example there of a cow crossing the Porcupine. They reach the calving grounds and it's a very benign type of area compared to where they have just come from. This is a view on the Jago River in Alaska where we conducted a sound simulator experiment on the calving grounds, and you will see the grazing of cows and calves. Much of it looks like this. As I indicated earlier, they are not in large herds at this time, they are distributed over very large areas. You will notice how well-drained that appears to be, much of the snow has left in contrast to other areas.

Following calving, many of the bulls in the population arrive. This is prior to the formation of and following the post-calving aggregation. This is movements following the aggregation. The bulls arrive and the other herd components, and we have the onset of the summer movement with the calves growing very, very rapidly. The cows and the bulls now in velvet, their antler development quite advanced.

You've heard reference to caribou in these dense groups on summer movements. Here is a group in the British Mountains, up at the very highest of elevations to avoid insect harassment during this period of the year. This is the height of the fly season. They'll often reach for very high elevations or ice pans or areas of high winds. They

cross rivers in these dense groups during the courses of summer movement. This is a westward -- or sorry, an eastward movement across the Firth River. Here is an eastward movement across the Kongakut River in Alaska.

That's what it looks like at a little closer view. You notice that even though there is obvious movement taking place, the animals are grazing as they move. This is very characteristic, caribou are wanderers, they are very nomadic, they don't settle down for very long in a given area.

I talked about the August dispersal. You'll see a few black dots. This is the coastal plain actually looking west from the Richardson Mountains. At the time during August in which the animals are very widely dispersed over the landscape, they are dispersed right from the northern Richardson Mountains right through to Alaska. That's when they put on their fat, that's when they restore their energy reserves. This is some of the area that that dispersal takes place in, in the last two years some of the wintering at the northern foothills of the Richardson Mountains.

The fall migration is the time of the rut, the breeding period. Bulls have shed their velvet, they have their manes, are in very good condition and it's the time of movement back to the boreal forest, the winter range.

Just a few slides now, I made reference to some experimental and disturbance studies that we have carried out. Here is a shot of a caribou

utilizing a seismic line in the Eagle Plains area south of Old Crow. Here I believe on Old Crow Mountain part of our experimental study to ascertain the effects of compressor station noise on caribou, and there the two compressors are set up and this was during the spring migration.

The last shot is, we have heard about the propensity of caribou utilizing roadways. Here's a shot of them utilizing a gravel road in the area of Prudhoe Bay.

That concludes that.

Mr. Commissioner, I have just one parting word. Throughout all this I have talked about the gas pipeline. You've heard me conclude that the migration is vitally important. I would like to express my concern that there are situations that pose threats to the Porcupine herd, and I think it should be stated now, so that we are aware of them, and I think I personally am very concerned about the impact of the Dempster Highway on the herd, inasmuch as it involves those factors such as vehicular travel, a highway through their spring migration route and so on, and I would just like to point out that very close attention will have to be paid by various governmental agencies to ensure that that herd is maintained in its productivity with respect to the access provided, the impact of the Dempster Highway.

I would not feel comfortable knowing that we have discussed the pipeline at great length with respect to the herd, and ignored some of

the other things that are going on, and I would view I think that that has to be a consideration for that herd. That's my comment.

THE COMMISSIONER: Thank you very much, Mr. Jakimchuk.

Well, we might be better to adjourn now, Mr. Marshall.

MR. GOUDGE: It would be helpful if we could adjourn now. I have advised counsel that I think it might be useful if we met for a short time and discussed the order of cross-examining this panel.

THE COMMISSIONER: All right, well we'll adjourn now till two o'clock.

(PROCEEDINGS ADJOURNED TO 2 P.M.)

(PROCEEDINGS RESUMED PURSUANT TO ADJOURNMENT)

THE COMMISSIONER: Well, I think we're ready to begin.

MR. MARSHALL: Thank you, sir. I would ask Mr. Hemstock to outline the mitigative measures.

WITNESS HEMSTOCK: Mitigative measures described by the applicant were developed as a result of many, many consultations between environmental and engineering personnel and as a result of the stated policy of the company that the protection of the northern environment was of prime importance. It was a matter then of sitting down with all of the disciplines and attempting to provide an optimum course; one which would not necessarily be best for any single discipline but which would in the overall provide the greatest facility for total environmental protection. I should probably point out too that I do not regard the present proposal for mitigative measures as a static proposal. Studies are continuing, a great deal more will be learned through disturbance studies and on-site evaluation of northern pipelines between now and the start of construction, and it will be my object to see that efforts continue to improve and upgrade our protective measures.

Arctic Gas has already taken many of the steps which are required to ensure that the mitigative measures are implemented. These involve the studies which have already been completed and the gathering together of the broad knowledge about the

environment which is illustrated, not only in the application but also in the various reports which have been published. In the next phase of the planning, which we perceive as being design engineering, where more detailed knowledge is gathered on specific sites and where more precise information is prepared with regard to design, the input will be received from all of the environmental disciplines in order to ensure that good engineering design is also good environmental design. Finally, when it comes to the construction, the mitigative measures will be implemented through the use of inspectors. The inspectors will have adequate training in the environmental disciplines and a knowledge of pipeline construction. The inspectors on each spread will be responsible to the Arctic Gas spread manager for day to day field work but will have as well direct contact to the Director of Environmental Studies with regard to technical matters. They will be on the site at the various spreads in order to make sure that baseline conditions are as expected and that these conditions which are then found on-site are still best handled by the mitigative measures outlined. It is a matter of company policy that such mitigative steps will be taken, and that every measure possible will be implemented in order to prevent undue disturbance of the natural environment.

Now to treat impact assessment, my overall assessment of the environmental impact of the project is described in Chapter 7 of 14.d. This chapter discusses the environmental impact of the project

in both the short-term and long-term under eight major headings, and these are: terrain and minerals; water resources; air; aesthetics; vegetation; fish; birds; and mammals. The changes to the environment are considered in four ways:

1. The nature of the change which consists as we perceive it, in the physical alteration of the topography and the vegetation;
2. The potential secondary alterations such as siltation or erosion;
3. The alteration to the natural undisturbed environment due to the presence of machines and people;
4. The secondary alterations which result from No. 3, such as harassment.

The degree of change is also a factor and consists of the immediate extent and intensity of the alterations, and the secondary scope of the alterations. A brief review of the impact of the project by separate disciplines is contained in the assessment statement. Previous panels have discussed terrain, air and water.

Section 7.2, 7.3 and 7.4 have been dealt with by a previous panel. Section 7.5 deals with aesthetics. There will be an alteration of a limited area, both along the pipeline and at compressor stations and these structures or installations will, in fact, change the original condition. The applicant has considered the various aesthetic concerns during detailed planning and construction so that insofar

as possible, the essential quality of the landscape upon the completion of the pipeline will be as satisfactory as possible. It will be the object of those concerned with aesthetic considerations to make both the pipeline right-of-way and the pipeline installations blend as closely as possible with the present landscape.

It was deemed that there would be little impact on the archaeological resources in the north because the preliminary surveys will locate sites on or near the right-of-way and allow either early salvage or minor re-routing of the pipeline to avoid the sites.

Professional archaeologists will be employed to supervise the work and make sure that the materials recovered are properly recorded and assessed, and the results made available to the scientific community.

Now to summarize the impacts, it has been Arctic Gas policy to consider advice from all of the environmental consultants with regard to the pipeline route and construction and operating factors and to accommodate where possible their recommendations. It should be noted, however, that it is the responsibility of the staff of Canadian Arctic Gas to arrive at a final judgment in the event of conflicts between the various disciplines studying the environment.

It was my responsibility to see that the environmental impact stated in Section 14.d of the application met the guidelines set by the government and that it accurately reflected the information received from our specialists in the various disciplines.

With regard to vegetation, it is my opinion that in terms of habitat the vegetational effects will be minimal. There will be an edge effect along the right-of-way and agronomic species will be introduced for the short-term but they will be replaced by native species. The early 1940 seismic lines and winter roads and those of more recent times well illustrate the natural restabilization which takes place in disturbed areas in the Arctic.

With regard to fish, one of the major concerns is the matter of siltation. However, the very small portion of the stream basins that will be affected by the pipeline activity and the practice of winter construction would indicate to me that the impacts here would be short-term and localized.

Oxygen levels are low in northern waters in winter and the applicant is fully aware that extra precautions will have to be taken to prevent the inflow of any contaminants into water courses. In all the years of shipping up and down the Mackenzie and in particular the last decade of moving chemicals and fuels to drilling well-sites, the record has been good and the applicant will strive to make it better in the operations which lie ahead. More access as a

result of the development will mean more fishing, and this of course must be controlled through the game management process.

With regard to birds, I believe that the impact of habitat loss on birdlife will be minimal. Our greatest concern lies in the matter of disturbance - disturbance of populations at critical times by human activity, by noise and by aircraft overflights. We will do our utmost to control the activity of those employed on or on the periphery of our area of activity in order to minimize disturbance. There is nevertheless a core of activity which must go on in the summer during construction of compressor stations. There will be one year of major activity along the coast for shipment of major amounts of freight to the construction sites. I do not believe that there would be much impact from staging during the short periods required for this activity which will include, of course, the off-loading of barges and the construction of the necessary staging sites themselves.

A greater concern might be that of activities over the long-term with regard to the operation of the pipeline. This will include the servicing of compressor stations and the inspection of the pipeline. The applicant states that one to three flights per week at higher altitudes and on controlled flight paths will be required to service the compressor sites, and that one or two flights per month along the right-of-way at low altitude will be utilized for

pipeline inspection. I submit that this amount of air traffic must be evaluated in the context of past activity in order for us to project the probable new impact on birdlife. We know that the Dew Line was constructed and maintained at sites along the Arctic coast and that much of the support of this activity was by air. The level of activity for Dew Line sites, while not directly comparable, certainly shows that the coastal plain has been subject to disturbances in the past and that the pipeline construction and operation is not markedly different in total than some of the past perturbations.

As noted in 13.b.1, one to three flights per week are expected to be required for servicing compressor stations. To serve the critical North Coast of the Yukon area with its three stations would require from 20 to 30 hours of flying per month, or 240 to 360 per year. The schedule could be reduced during the critical three to four weeks the birds are staging for migration.

With regard to mammals, the main concern is with the Porcupine caribou herd. The impact, in my opinion, will be alleviated by winter construction and by the monitoring and controls which the applicant will apply during the construction and operation. Other large mammals will not be greatly affected. Furbearers are not likely to be affected as to numbers and the edge effect of the clearing of the right-of-way will change and perhaps improve some minor habitat, but nevertheless will be a small impact in the

overall scheme.

Q Thank you, Mr. Hemstock, and now Dr. Banfield.

WITNESS BANFIELD: Mr. Commissioner, the purpose of my testimony is to evaluate from an overall environmental or ecological standpoint, the applicant's proposal in this proceeding, having consideration for the impact of the construction, operation and maintenance of the proposed pipeline and related facilities principally upon vegetation, mammals, birds and fish life in the area in which the pipeline would be located.

I would like to explain my role in the project. In March, 1971, the predecessor to Northern Engineering Services invited me to serve as a consultant in the field of mammalogy. It was proposed that I should undertake a general review of the mammal research studies which were to be conducted by Renewable Resources Consulting Services Ltd. The actual field work would be conducted by Renewable Resources and my work would be to review its planning and research. I was asked to go into the field and work with and advise the field staff, and to review the field reports. I commented to Renewable Resources and Northern Engineering Services on such reports as far as the scientific excellence or logic was concerned and with respect to the need for certain research projects.

Since 1971 my role in the project has evolved into one of serving as a general environmental consultant. Over the past several years

the officials of Northern Engineering and the applicant have asked me questions dealing with subjects other than mammalogy, and I would give them my opinion or advice. There is perhaps a very good reason for this, inasmuch as I have had extensive field experience of a very general nature. For instance, in my caribou studies in the 1940's, I was required to do all of the vegetation analysis myself, and therefore am familiar with the literature on Arctic ecology from a plant ecology standpoint. In addition, I am familiar with climatology and the physical environment of the Arctic.

Also, since 1971 I have become interested in the philosophy and practice of environmental and sociological impact assessments. It is my general interest, coupled with the experience which I believe has led me into a role of a more general nature, i.e. the review of the environmental studies.

I have been involved from the outset of the environmental work in the project and have had a role in determining the types of studies that ought to be undertaken. I suggested a number of areas that ought to be investigated, for example, an archaeological salvage study. I also suggested studies relating to mammals, namely: a study of the environmental impact of compressor station noise on wildlife; and, a study on whether native mice would destroy the grass that would be replanted on the right-of-way. I was responsible for recommending the study of the effect of the pipeline on fur-bearers and the impact of that effect on the native trapping industry in the North.

I was consulted with respect to employment of individuals or firms to do some of the environmental studies that were carried out. I have had a role in reviewing the reports of the consultants as they have come out and I have been involved in the editing process with respect to many of these studies. In this regard, I participated in the preparation of the environmental assessment portion of the application. I have, particularly in the area of mammal studies, been more directly involved in assuring that a good research program in Northern mammalogy was undertaken.

Finally, I have attem ped to maintain a continuing dialogue with environmental and conservation groups in order to determine their concerns with respect to the environmental impact of the project.

THE ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

I would first like to comment upon the environmental impact assessment process and the methodology of environmental impact prediction. The art, or science, of environmental impact assessment is still in its infancy. The American National Environmental Policy Act of 1969, is generally accepted as the starting point. Up to the present, government guidelines have been very general and only a few assessment methods have been tentatively recommended. There is no generally accepted single method of analysis. The environmental impact studies sponsored by the applicant commenced in the spring of 1971, and may be considered as pioneer studies in the field in Canada.

In terms of the environmental impact assessment process, it is significant that in this project, environmental planning was conducted from the beginning simultaneously with engineering planning. Both environmentalists and engineers addressed themselves to the concerns of alternatives, long-term and short-term impacts, direct and indirect consequences as well as cumulative effects of the pipeline on other facilities.

It is also significant that in this case the environmental impact assessment was conducted prior to approval being granted for the project. The environmental impact studies of several similar large projects were conducted after the decision had been made to go ahead with the project, or after con-

struction had been commenced.

I would also like to comment upon the relationship between environmental impact assessment and environmental protection. Environmental impact assessment naturally forms part of the engineering planning phase and final design stage. At that time mitigative procedures and contingency plans may be developed. Environmental protection is an active phase commencing at the construction stage and is accompanied by environmental monitoring. It is the responsibility not only of the sponsor but also of the governmental agencies involved and the concerned public. The environmental consultants engaged by the applicant were charged initially with the environmental impact prediction and later with defining mitigative procedures and monitoring. The Environment Protection Board has directed its attention primarily towards the subject of environmental protection.

ENVIRONMENTAL IMPACT ANALYSIS

One of the earliest methods proposed for environmental impact analysis was the environmental matrix of Leopold, et al (1970). The matrix format indicates the interactions between environmental factors on one axis and construction and operational activities on the other axis. And excellent example of the environmental impact matrix has been presented by the Environmental Protection Board's 1974 Report No. III. Several authors have pointed out serious shortcomings of the matrix method of environmental impact

analysis. In the first place the matrix lists only simple direct relationships between an environmental factor and one human activity. It cannot deal with complex inter-relationships involving several factors. We know that ecological relationships are typically a complex network of relationships between organisms and their environment. Secondly, the matrix is a static instrument. It deals with conditions at one point of time, it cannot describe a dynamic situation. We recognize that nature is constantly changing plant succession for instance. Finally the information provided in the matrix is of limited value. It may simply indicate impact or no impact, or provide a colour or figure indicating on an ordinal scale, indicating an ordinal scale such as high, medium or low impact. Such data are personal value judgments of the designer and not subject to strict statistical analysis.

It is now recognized that such a matrix is best used to identify environmental concerns, rather than to present a final environmental impact assessment. The environmental consultants asso ciated with the project chose not to present such a graphic representation in the Environmental Impact Statement 14d, because of these limitations. However, at an early stage of the studies such environmental concerns as the effect of compressor station noise on caribou and the effect of regular maintenance flights on staging snow geese were identified in list form for further study.

Indeed, the consultants associated with this project chose to use standard scientific experimental methodology to obtain quantitative data from impact simulation studies. The main advantages of this method are that quantified data are obtained, decibels, miles, altitudes in feet, numbers of animals responding to a disturbance, etc.; and these are subject to normal statistical analysis. These data may be judged objectively by a second party choosing his own criteria and standards. Another advantage is that this information forms part of the general science data base available to all scientists interested in northern ecology.

Another method we might have used is the cost/benefit analysis. This method may be used effectively in certain natural resource cases such as an evaluation of the impact on the trapping industry. However, it would not be acceptable for an overall environmental impact assessment as many environmental values such as "wilderness" are intangible and not equatable to dollars and cents.

We have made use of one of the standard methods of environmental impact analysis in the presentation of map overlays as represented by the wildlife distribution atlases.

Several environmentalists (including those among our own consultants) proposed an ecosystem approach as the ultimate goal in assessing the environmental impact of the project. Hopefully at some future date such an analysis may be possible. Unfortunately, at this time we do not have the techniques, nor baseline case studies available for comparison. Currently this method calls for extrapolation of findings from the I.B.P. sites at Point Barrow, Alaska, Devon Island and Char Lake, Cornwallis Island (in the Canadian Arctic Archipelago). Originally it was thought that the Arctic and Subarctic ecosystems were "simple". We are now learning how many varied ecosystems there are in the north. Certainly each of the main tundra plant communities compose a distinct ecosystem type as well as several in the coniferous forest. Aquatic ecosystems include: marine, esturine, coastal lagoons, lakes, tarns -- that's a Scottish

word by the way meaning tundra pool -- and several river and stream ecosystems. A complete analysis of energy flow through all of these is an impossible task at present. As a result of these considerations we chose to study the important "indicator" species such as spruce, willows, sedges, grasses, caribou, wolves, geese, raptors, Arctic char and grayling. These are not only important economic species to man but are dominant links in the energy flow through their ecosystems. If an important dislocation were to be produced in an ecosystem, it would probably be identified early in the population change of one of these "indicator species".

Frequent mention has been made of the baseline studies conducted by the Applicant during this hearing. Very few intensive studies had been conducted in the region through which the pipeline might pass because of its remoteness prior to the initiation of the Applicant's environmental program.

I believe it is generally recognized that in this case industry has made a tremendous contribution to basic environmental studies in Northern Canada and in Alaska as well, particularly the northeast corner of Alaska. Government agencies and the foundations such as the Arctic Institute of North America had not previously had the funds to undertake studies at the level that has been undertaken with respect to this project. The project has made a major contribution to our knowledge of fish and wildlife in

this large area of North America. I believe that we now have sufficient information to form the basis of an adequate environmental impact assessment and of mitigative procedures to protect the environment.

In the field of predictive studies, we must recognize our limitations at the present state of knowledge. After all we are still having trouble in forecasting tomorrow's weather, the stock market closing quotations, or next year's unemployment figures. It is perhaps rather glib to state that the future is dynamic. It is difficult to predict the imput of many dynamic variables to future events.

"Worst Case" analysis has become a recognized part of the environmental impact analysis since 1972. It is comparable to conservative engineering design specifications for buildings or bridges. It is also used in the land use planning process. It is related to risk prediction. True, "worst case" examples are based upon long records of events that can be reduced to a probability. Such records are: 50 year flood levels, ship collisions at sea, pipeline ruptures per mile/year, train wrecks per mile/year, air disaster per air-mile, or earthquakes of magnitude 6 (or 8) per 100 years. Each such data -- with such data on hand one can predict a "worst case" using whatever criteria you wish: 50 year flood levels or 100 year seismic risk. Unfortunately, we have not built up many of the required data for northern

Canada to offer a valid "worst case" prediction. In the case of the caribou, for instance, the worst case histories described in the literature relate to the construction of railways and permanent roads across caribou range. The data for elevated pipelines are also suggestive. I am not aware of any data associated with the construction of a buried pipeline that would offer the basis for a worst case prediction.

Scenario writing is also considered to be a legitimate method of future studies. A scenario describes a possible course of events assuming certain conditions, usually starting with current events. A number of scenarios relating to the same variables should be compared. There are several well known realistic but disturbing scenarios in ecology such as Rachel Carson's introduction to Silent Spring (1962) or Erhlich's Eco-Crisis (1970). Some forecasts of dire consequences to caribou or snow goose populations as a result of the construction of a northern gas pipeline must be recognized as similar "environmental doomsday" scenarios. They are personal value judgments that should be balanced with other more optimistic scenarios in the decision-making process.

For my part, I would prefer to draw conclusions based upon our simulated impact studies and the generally accepted literature on caribou ecology and behaviour. Over the past 40 years the caribou herds have been studied scientifically in Canada, the numbers have waxed and waned. We have thought that factors such as climate, forest fires and hunting have been important factors, but the records do not always confirm our opinions.

The acceptability of the environmental impact. When an environmentalist reaches the point of drawing a conclusion from his impact analysis, he finds that there is no generally accepted method of stating his conclusions. In most cases environmentalists are forced back to use personal value judgments in expressions such as,

"little environmental impact, or serious detrimental environmental impact."

More recently authors have defined their expressions in more objective terms such as,

"loss of 10% habitat," etc.

I favor the test for the acceptability of expected environmental impacts by comparing the predicted environmental effects of the proposed human activity with the observed environmental effects of natural disturbances. At present this test is only in the conceptual stage and can only be used as a method of direct observation. In the case of some environmental factors such as dissolved solids in aquatic ecosystems, the quantified

data are available to test the concept at a mathematical level. This has been done in the U.S. Department of the Interior's Final Environmental Impact Statement on the Garrison Diversion in North Dakota, 1974. There, the predicted increase in dissolved solids in the rivers was compared with the fluctuations in the natural loads before implementation.

There are many natural disturbances such as solifluction, slumpings of the active layer, caribou trails, wildfire, and stream erosion which cause local environmental disruption to certain physical and biotic components in the environment. However, other natural forces such as soil erosion, sedimentation and plant succession heal the disturbances in a natural time span. I believe that where, as here, the impacts resulting from human activity such as clearing a right-of-way, trenching, backfilling, and crossing rivers are no greater than disturbances due to the natural phenomena discussed above, and especially where we are assisting natural plant succession by revegetating the right-of-way, then the environmental impact is acceptable.

I have proposed that the comparison between impacts should be based upon local natural disturbances. A problem is encountered in extending the comparisons over such a broad scale as to include natural catastrophes such as earthquakes, volcanic eruptions, or 100-year flood levels. Such extreme examples might not be considered as acceptable impacts by many. One must set arbitrary

limits to the scale. I have chosen to use a comparison natural disturbances such as stream erosion, active layer slumps, solifluction, natural fires that occur with a frequency of about once in five to ten years. This approximates the time scale in which we expect the revegetation of the right-of-way to be effective.

While this test applies well to the pipeline right-of-way, it is less effective when applied to the construction and operation of other facilities such as compressor stations. The environmental impacts of such facilities are site specific and must be analyzed individually. There is still one component of the total impact that might be treated objectively on a comparative basis, that is the amount of habitat removed by the gravel pad from the total habitat available to populations of plants and animal species. This might be compared to landslides in mountainous terrain. However, a large component of the total impact of these facilities falls within the area of aesthetics, which is subject to differing personal value judgments. This problem was discussed in the Garrison River Diversion Environmental Impact Statement and such impacts were described as problematical. In these cases we are forced to use the language of personal value judgments such as little or major environmental impact.

'Similarly, there is no method available to evaluate the total impact of the project on the combined components of the environment such as fishes, birds and mammals, from an overall standpoint.

Quantitative data can be collected on the responses of individual environmental components to different magnitudes of disturbance. For example, we can measure responses of snow geese to aircraft disturbances, or caribou to simulated compressor station noise. Unfortunately so far the summation of the relative importance of these disturbances to geese and caribou is still in the area of personal value judgment of experienced environmental biologists, or better a team of experienced biologists.

For my part, I still try to quantify my conclusions.

In this instance since both snow geese and caribou are herbivores in the ecological scheme, they are strictly comparable, their combined population biomasses may be compared to obtain a figure of relative ecological importance. Or you might consider their importance as food to northern native residents. (In each of these comparisons, the caribou appear to be more important).

Cumulative impact assessments. We recognize the complex web of relationships between man's physical environment, cultural backgrounds and social and economic factors. Few attempts have been made by systems biologists to produce conceptual or mathematical models of the world system. The general systems approach is to break down the larger system into smaller sub-systems and to study the inter-relationships within each, and then try to fit them together.

In this case we have studied

the environmen tal impacts of the proposed pipeline as a component of a larger complex. Others have studied other components such as the impacts of the petroleum production industry.

Many future developments in the north such as political evolution, population growth, growth of service industries, perhaps a railway are quite unpredictable at the present. I think that each future major development should also be analyzed for its social and environmental impact when each is proposed.

Mitigative Procedures -- When I became associated as a consultant to this project, I started working with the engineers and other environmental consultants. Through our review processes we have been able to isolate each one of the environmental concerns. We have attempted to define each concern in a context in which it could be investigated, that is, in terms in which quantitative data could be gathered and the results obtained objectively appraised.

The major engineering features, that is, the buried and chilled pipeline, backfilling and re-vegetation, laid to rest much of the environmental concern which I had. Adjustments to the routing of the pipeline away from sensitive areas laid to rest other concerns. Arctic Gas' test facilities demonstrated its ability to mitigate potential adverse physical environmental impacts. Other procedural adjustments were made: the use of winter roads, and ice roads, light impact-wide tracked vehicles, the development of management procedures such as control of personnel, aircraft flight patterns, and local terrain restoration procedures. It was simply a matter of running down concern after concern, documenting it, collecting data on it, simulating the real situation where possible, and then taking readings of how wildlife actually responded to these simulated situations. Of course, we are still confronted with actually building the pipeline and encountering unforeseen problems. But here we must rely on contingency planning to deal with individual problems as they may occur in final design.

It may take innovation from time to time, but I am confident innovations will be forthcoming to deal with local problems.

Residual Impact -- As a result of my overview studies I have come to the conclusion that the construction and operation of a buried, chilled pipeline along the Applicant's Prime Route will not have a significant detrimental impact on the components of the living environment. It is my opinion that there will actually be little direct adverse impact on wildlife, fish and vegetation along the proposed route if it is constructed and operated according to the plans developed by the Applicant. Most of the detrimental impact will be indirect in nature as a result of increased human disturbance. With the completion of the Dempster and Mackenzie Highways increased future human activity along the route is inevitable.

I have also concluded that the proposed Prime Route is significantly preferable to the Interior Route, on the basis of an overall assessment of biological environmental concerns.

I admit that these conclusions are largely personal value judgments, but they are supported by the Applicant's quantitative experimental data and twenty five years experience in northern ecological research.

MR. MARSHALL: Thank you, Dr. Banfield. Mr. Hemstock, I believe you indicated in

your evidence that you had overall responsibility for the preparation of the environmental statement for Canada, north of sixty, which is marked Exhibit 57.

WITNESS HEMSTOCK: A Yes, sir.

Q I take it, it would follow then, sir, that you support the summary of the impacts that are set out in the exhibits?

A Yes, sir.

Q Mr. Dabbs, within the area of your discipline, do you have any comments to make on the impact, the environmental impact statement Exhibit 57, as it pertains to vegetation? Do you support the summary of the impacts that are set out in the exhibit as they relate to your discipline?

WITNESS DABBS: A I have no other comments and I support that.

Q Thank you. Dr. McCart, in the area of the aquatic environment, are you in agreement with the summary of impacts that are contained in the Exhibit 57?

WITNESS McCART: A Generally yes.

Q Do you have any other comments that you want to make pertaining to it not already spelled out in your evidence?

A No, I think not.

Q Mr. Jakimchuk, in the area of mammals, do you agree with the summary of the impacts as set out in the environmental statement of the

Applicant -- Exhibit 57?

WITNESS JAKIMCHUK: A Yes, I do.

Q Mr. Gunn?

WITNESS GUNN: A I would like to make exception to Dr. Banfield's theory that bigger is necessarily better when comparing caribou and snow geese.

MR. MARSHALL: I think we could all see that one coming, sir. Dr. Gunn, specifically with respect to the environmental statement of Arctic Gas which is marked as Exhibit 57, the Environmental Statement of Canada, North of Sixty,are you in general agreement with the summary of the impacts that are set out as they relate to your discipline?

A That is not what we know as 14D, is it?

Q Yes, 14D.

A I have a few minor -- I agree with it in general terms. I have a few minor disagreements but they are all of a minor nature.

Q Fine, thank you. I have no further questions of the panel. Mr. Commissioner, Dr. Gunn mentioned to me that there has been a film prepared that describes the environmental research that has been carried out and includes a description of the disturbance studies that were carried out and it is entitled "The Arctic, The Wildlife, The Pipeline". It was produced by Robin Gunn Ltd. for Arctic Gas in 1973.

It is a 28-minute film. The members of the panel thought that it would be of interest to the Inquiry.

I'm not suggesting we show it now, sir, perhaps I could speak to Mr. Goudge about a suitable time. I think my learned friend is anxious to commence his cross-examination but I think perhaps later in the week or when the panel returns we'll find an appropriate time to show the film.

THE COMMISSIONER: Certainly, fine.

MR. GOUDGE: Or it may be, sir, that it will have material in it that would form the basis for questions. It might be better to do it earlier rather than later in the process of dealing with this panel.

MR. MARSHALL: Well, the film is here, sir. It would just simply be a matter of setting up the projector which we could do.

THE COMMISSIONER: You haven't seen it.

MR. MARSHALL: I haven't seen it. Mr. Carter has seen the film and I believe Mr. Goudge has seen it.

THE COMMISSIONER: Well, why don't we --

MR. MARSHALL: We could break for coffee now, sir, and then set it up and show it. Is that -- ?

THE COMMISSIONER: Well, I was

going to say, let's start off with some cross-examination and then at coffee break it could be set up. I thought we might wait till 4:30 or 5:00 and show it then when we had pretty well run out of steam or gas and everybody would welcome just sitting back and seeing a film.

Just before we go on to anything else. Dr. Gunn, you said that the pipeline along the coast would do more damage from an ornithological point of view than it would if it were to run along the interior and Mr. Jakimchuk, you said it more damage if it were to run along the interior to the mammal population generally than if it were to run along the coast. Dr. Banfield, I take it you would agree with Mr. Jakimchuk's proposition?

WITNESS BANFIELD: A Yes, sir, I also agree with Dr. Gunn's analysis as well that if one were to consider the pipeline solely on the basis of ornithological concerns, the interior route is preferable.

Q But you, yourself, considering it from an overall point of view think it would do more damage along the interior route than it would along the coast? That is, lumping the birds and the mammals and everything else into one big package?

A Yes, and including as much as terrain disturbance as well down that far.

CROSS-EXAMINATION BY MR. GIBBS:

Q You have heard Dr. Banfield

tell us that all is well, it seems a little to get down to some facts but perhaps I could start with Mr. Dabbs and ask him a few questions on his vegetation.

Could you turn to page 7 of your prepared evidence, Mr. Dabbs?

WITNESS DABBS: A Page 7, mine starts at page 11.

Q I beg your pardon.

A I'm sorry. Yes.

Q You have page 7?

A Yes, I have it.

Q And would you look at the last paragraph where you say that "to gain an understanding of the structure and to a degree, the function of botanical components of the ecosystems tra-ersed by the proposed pipeline, field investigations were undertaken which have produced the classification of the terrain and the associated plant communities."

Then you say, "By reducing the complex landscape to a manageable number of ecologically meaningful units".

How do you go about doing that?

A Just as described. It's a matter of classification of terrain to start with and then the classification of plant communities which are associated with land form units. These, then form those, what I consider ecologically meaningful units functioning biologically.

Q Well, describe for me an ecologically meaningful unit.

A Using then as an example which I think is the easiest way. The sedge -- using a simple one -- the sedge tundra communities associated with depressional land forms in the Arctic coastal plain. Those in themselves are a meaningful unit.

They repeat themselves again and again across the landscape.

Q A meaningful unit then is a type of soil with an associated kind of growth on it?

A A meaningful unit is a classifiable community which does encompass the soil and the land forms that it is associated with.

Q And in an ecologically meaningful unit can you have more than one type of growth on that particular kind of soil?

A Oh, yes.

Q And do you then plot out a piece of ground and consider that to be a meaningful unit and determine what the soil is and what the various types of growth are that are upon it?

A We never plotted it out or mapped it out as you described. We have classified and described those units in the various reports cited.

Q Well, sir I don't understand how you start with a complex and get to, and break it down into these manageable number because if you take a form of soil and everything that grows upon it, don't you have a complex landscape right there in your selection?

A Yes, you have a complex landscape to start with. That is quite true and it doesn't change the complexity of the landscape but it organizes the landscape into meaningful units that can be dealt with individually.

Q Well, what do you do? Do you take something like you said sedge, and determine

where it grows, all the different kinds of soil and terrain and drainage and all the rest of it in which it grows?

A Sedge communities is an example. Use another obvious one. The white spruce communities that are found on river flood plains is a unit in itself.

Q And when you have gone through all that, you must have a vast number of ecological meaningful units?

A There is a large number, yes.

Q And how does that help you to understand the complexity of the total landscape?

A Well, sir without it, you would be speaking of something completely undefined, unorganized in your own mind. A classification of any system, whether it is a plant community of the Mackenzie Valley, whether it is a classification of genetic units within a species, is a function of a human mind that we have to organize things into related units before we can deal with them.

Q Well, maybe I am making it overcomplicated then. It is sort of a shopping list of what kind of plants grow on this kind of soil and this kind of temperature and drainage system?

A It is a matter of classical plant ecological investigation which starts with the classification of landscape. I am not sure what your question was just now.

Q Well, really it is a list of plants that grow in various parts of the northern environment. Isn't that what it is?

A Not quite because a list of plants can be generated without any classification of plant communities. I think the concept here, that may be escaping us in this discussion, is that of communities, plant communities. We can list all of the species off. Maybe we would have 400 species in the Mackenzie Valley but we don't have 400, necessarily have 400 plant communities.

Q No. So what you do then is what I said. You select an area of ground and you determine what is in that plant community?

A That may be the procedure in arriving at that classification, yes.

Q Well that was what I was trying to get at. What procedure, how do you get to these meaningful ecological units?

A Well if that is the question, we could go through the steps very briefly. Vegetation is firstly organized by the influences of a climate on a broad scale, as we have discussed, as everybody in the room here is quite aware of, the change of structure from north to south, south from the tundra through open-forest tundra, through the boreal forest. That in itself is the first level of organization.

The next level of organization would be in the physiographic units. I think physio-

graphic, that in itself is another level of organization. In those physiographic units there is a breakdown of the terrain into land forms and I believe Dr. Mollard has gone on at considerable length defining for you what a land form is. That in itself is the next level of organization.

On those land forms then biota have organized themselves under the influence of climate and microclimate and material exposure etc. into communities that are associated with different positions on those land forms so that on one large land form you can have more than one plant community type. So that is the level of organization I am speaking of sir, so that we have them in some logical sequence and organization in order to deal with them in some logical manner.

Q All right. I understand. Would you turn now to page 8 of your prepared evidence, please. And again the last paragraph on that page, "A third area of research which has been underway for the past three years has been one of environmental monitoring. The objective of this program was to establish the natural conditions of drainage, soil and vegetation in a representative study area in the Mackenzie Valley prior to construction of either a highway or a pipeline." Where was the representative study area located?

A The particular study area referred to here is the Chick Lake Basin, Donnelly River system about 70 miles north of Norman Wells.

Q And how large would the study area be?

A I would have to check the map to give you an exact figure in numbers of square miles. It is an entire lake, river, drainage system.

Q I don't need exact numbers. Can you tell me roughly in miles what dimension it was?

A The area covered in the study would be approximately 50 square miles as I recall from the map.

Q And you say, sir, that that is a representative study area? Do you intend to convey by that that the results obtained from your monitoring there, would apply anywhere throughout the length of your pipeline route?

A No, sir. It is representative of the mid-Mackenzie Valley.

Q Of that area of the Mackenzie Valley?

A The mid-Mackenzie Valley.

Q And so that really the results of your environmental monitoring there, really are of no help other than in that mid-part of the Mackenzie Valley?

A No, they are intended only to monitor changes in that area.

Q And have you plans for any of these representative study areas anywhere, anywhere else along your pipeline route?

A We have plans. We have made suggestions for future investigations to the client

Q Where?

A Those areas haven't been selected as yet but they would to be representative obviously we would need a situation in tundra regions and probably in the southern Mackenzie Valley.

Q Well you say later in that paragraph, "The objective will be to return to the same site during the time of construction and for a period of time following construction in order to measure and confirm environmental impact predictions". Are the environmental impact predictions contained in a volume that has been filed with us here?

A Yes, I am referring there to our predictions as I made in Exhibit 14 B.

Q I see. Will you turn now Mr. Dabbs, to page nine of your prepared evidence. And in the first paragraph you are speaking of a vegetation survey program and you say,"In 1947 the program was extended to include a case history study of existing pipelines in western Alberta, through the Crow's Nest Pass into British Columbia and across southwestern Saskatchewan. Would you define what you mean by a case history study?

WITNESS DABBS: A study of existing pipelines, sir; of course studies in the Mackenzie Valley have not been able to address themselves to an existing pipeline as one simply doesn't exist. In this case south of 60 there are pipelines in existence largely parallel to the proposed Arctic Gas line that lend themselves to study.

Q And what were you studying in that case history study?

A We were examining the problems that had been associated with construction of pipelines as they deal with our field of restoration and erosion control, identification of erosion problems as they relate to different river crossings or terrain types;during the course of that work, of course, we did carry on a fair amount of sampling of currently undisturbed communities, forest communities as a data base or the calculation, up-dating of forest productivity tables for Alberta, in order to assess the loss of timber if a right-of-way is cleared through such areas.

Q What pipelines did you study?

A Through Alberta we studied the Alberta Gas Trunk Line system largely.

Q Not the entire system?

A No, not the entire system. The main trunk line south from the Hay River crossing, I don't know what the name used to refer to it, and at a number of places along the eastern slopes of the foothills,Alberta.

natural gas pipeline through the Crowsnest Pass into British Columbia, Kingsgate, places along the Alberta Gas Tunk Line system as it crosses agricultural lands en route to Empress and of course places on the TransCanada Pipeline system in Saskatchewan.

Q And was it part of your objective to learn something there which would be applicable north of the 60th Parallel?

A No, sir, the objective there was to know what we could about pipelines and their impacts in Alberta for that leg of the Arctic Gas project.

Q You don't expect to extrapolate any of what you learned there into any area north of the 60th Parallel?

A If it's possible, perhaps, but our objective was not necessarily to do so.

Q And is that case history study contained in any report or document that's been filed with this Inquiry?

A Not as yet;it has not been completed.

Q When do you expect it to be completed?

A In the next couple of months, but I would have to consult with the author.

Q You didn't conduct the study then?

A No, a member of my staff

conducted the study.

Q Could I enquire of you, sir, through Mr. Marshall, whether this study will be produced when it's been completed, to Mr. Commissioner?

MR. MARSHALL: Who do you want to answer the question, the witness, me, or the Commissioner?

MR. GIBBS: I asked the Commissioner if I could enquire through him of you whether the study would be produced when completed.

MR. MARSHALL: I don't see any reason why it couldn't be. Mr. Hemstock can speak for the company as to what their plans are for publication of it. Will it be published?

WITNESS HEMSTOCK: I see no problem in publishing it.

MR. GIBBS: It will be voluntarily furnished here when it's ready, is that right, Mr. Hemstock?

A Yes.

Q On the same page 9, in item No. 3, Mr. Dabbs, you say that your survey program in 1975 was to indicate some of the problem areas on the pipeline route and make recommendations regarding terrain stability based on the vegetation study. Is the result of that, that 1975 survey which you refer to in paragraph 3 in a form yet that can be filed with this Inquiry?

WITNESS DABBS: No sir, these objectives as stated on page 9 are objectives set out

as part of the vegetative survey and that information is contained within the reports on each survey. So those surveys that have been published and filed -- that information is available and as other surveys are completed that type of information will be included.

Q Well, with specific reference to item No. 3, have you received, as a result of the 1975 survey program an indication of the problem areas and recommendations regarding terrain stability based on the vegetation study?

A I have not specifically as yet. It's being analyzed.

Q But you anticipate that you will?

A I do, yes.

Q And when do you expect to receive that?

A As part of the report that we just discussed.

Q In the next couple of months --

A Yes.

Q -- and as part of what Mr. Hemstock has agreed to produce.

A Yes.

Q And does the same answer apply to items 4, 5, and 6 on page 9?

MR. MARSHALL: I'm not sure I understand that. This is just a set of the objectives that apply to each of the survey programs.

MR. GIBBS: All right, sir.

MR. MARSHALL: If I understood --

MR. GIBBS: I'll do it so you can understand it, Mr. Marshall.

Q Mr. Dabbs, as a result of your 1975 survey program have you received information for right-of-way clearing and cost calculations based on shrub and tree cover?

WITNESS DABBS:
A That information has and is being calculated for the area south of 60 as part of specifically that '75 program. The data generated in that program has been used in those calculations.

Q But I thought that this 1975 survey program included the cross-delta route plus a new routing in the Fort Simpson area.

A Well, sir, we're confusing then what you -- or I have been confused by what you mean when you refer to the '75 survey. There are three different programs we seem to be talking about: (1) the south of 60 case history study; the 1975 cross-delta, and the Fort Simpson area. I would ask that you refer to them individually so that I understand what you're asking.

Q All right then, Mr. Dabbs, as a result of your 1975 survey program, have you received information for right-of-way clearing and cost calculations based on shrub and tree cover?

A Let me try and clarify that objective for you. What it is, part of any study

of forest communities in or generated on density tree size, age, growth rate, etc., that information is an important fundamental part of a plant ecological study. This information is similarly useful to other people, such as our land, in our land section, and our engineering section is interested and concerned with the clearing of right-of-way. I would say that as those reports are completed and that data is calculated, are calculated and tabulated, and if required by the lands people it is passed onto them. Now in the past it has, and I have reason to believe that they made a determination of densities, tree sizes, distribution, will similarly be passed along to the land section. It is not my responsibility to do those calculations, but we have set it as an objective to provide some of that information.

Q Mr. Hemstock, will that information also be passed on to this Inquiry?

WITNESS HEMSTOCK: Yes. I think that perhaps part of the confusion -- I'm not sure that I'm correct, but the specific objectives that Mr. Dabbs has listed here, as I understand it, apply to all of the programs right from 1971 on. The '75 survey program dealt with the cross-delta route and the new Fort Simpson area, the new routing to Fort Simpson. So the objectives apply to that, but the specific comments here may also apply to other studies right from the start.

Q Yes, well Mr. Hemstock, I may be wrong but it was my understanding that the

1973 results had already been contained within the material which was filed before this Inquiry. The 1974 one you're going to produce in a couple of months or so.

A Well, most of the 1974 results have been filed with this last group of reports which we just passed out. The '75 results will all be published in due course and it will be a couple of months yet.

Q Yes, and what I am asking Mr. Dabbs, perhaps I should be asking it of you, is whether the 1975 results will contain information on each of the objectives detailed in items No. 4, 5, and 6?

WITNESS DABBS: The information which is used for calculating an estimate of the clearing is just the type of information that I described, and yes, definitely that information on tree size, rate of growth, density, etc. as it has been collected will constitute the data contained in the report which will be published as completed, and I'm sure will be filed with this Inquiry.

Q The same thing will apply with respect to the growth characteristics of plant communities in the cross-delta route and the Fort Simpson area.

A As that data is available, and every particular study we undertake throughout such a broad expanse of country you are not always offered opportunities to gather data specific to each and every objective here, but as the conditions -- the situation within each of those surveys presented the opportunity to make those studies, they will have been made and those data will be contained within a report.

No. 6 is not always an objective that can be achieved through a survey such as the Fort Simpson survey. We may not produce a classification that's of much value to Dr. Gunn. For instance in that particular case, other surveys, definitely that has been the case.

Q Yes sir, and to get back where I began before Mr Marshall ceased to understand, everything, all of the results you obtained through that 1975 survey program will be in the compendium report or whatever it is that is brought to this Inquiry in a couple of months' time when it's ready. Is that correct, Mr. Hemstock?

WITNESS HEMSTOCK: Yes.

Q Turn to page 11 of your prepared evidence, please. Now, sir, here you're talking of revegetation studies, and I direct your attention to the beginning of the third full paragraph.

"The research conducted at the test facility at Prudhoe Bay, Sans Sault, Norman Wells, plus numerous additional test areas in the Inuvik, Tuktoyaktuk and delta regions, have led us to conclude that revegetation on the pipeline and associated facilities is feasible."

With respect to each of Prudhoe Bay, Sans Sault and Norman Wells, can you tell me when the re-vegetation tests began?

MR. DABBS:

A The Prudhoe Bay test-site -- I believe in all three cases they started in the spring of 1971.

Q And in all three cases can you tell me what kind of tests they were?

A I can give you a rundown of general tests. If you want to go into specifics we'd have to start consulting each individual report.

Q Well, let's just have the general to start with.

A The initial objectives from the outset were one of species trials. Dr. Bliss briefly discussed this in his earlier testimony to this Inquiry. As at the outside of this revegetation research there simply was no information on the performance of the available varieties of grasses or legumes with regards to their potential for revegetation in northern areas so the initial objective was simply one of species trials.

Q Meaning by that that at

each site you tried various species to see which one would grow.

A That's quite correct.

Q And over what time span did you observe the ability of each of the species to survive?

A Since the inception of the program in 1971, the Prudhoe Bay and Sans Sault test-sites, the monitoring has continued in each of those plots, the Norman Wells test-site I have annually examined but have not taken the time to quantitatively sample.

Q And are you satisfied, Mr. Dabbs, that the results you obtained at Prudhoe Bay, Sans Sault and Norman Wells, are sufficiently representative that through each or a combination of them you can apply those results to the entire length of your pipeline?

A I think, sir, I go on in my testimony as you read it to include plots in Inuvik, Tuk and delta regions, which have, as I described in an earlier panel, I greatly expanded the range of the work, the diversity of terrain, and climatic conditions, under which we have tested these various varieties and mixes and on the basis of this I will conclude yes, that it is feasible.

Q But your Inuvik, Tuktoyaktuk and delta tests are much more recent in time, are they not?

A The Inuvik tests, some of

which I referred to, were started, sir, in 1970 by Dr. Younkin under the direction of Dr. Bliss while dean at the University of Alberta.

Q And the other two, Tuktoyaktuk and delta?

A The Tuk sites also were started by Younkin. The delta sites have been added in the past three years.

Q And you're now satisfied that you have a representative set of test results that apply for the whole length of the pipeline.

A I believe that we can state with all confidence that it is feasible and that we have outlined as appendices to testimony the continuing studies that will go on to establish what are the variations that will be required to be applied to our plans for revegetation in order to establish final specifications.

Q All right, would you turn now to page 13 of your prepared evidence? Particularly the third full paragraph where you speak of a number of species proposed, for inclusion in the reseeding program being technically imported from Europe, introduced into North America some 50 to 200 years ago. Now, Mr. Dabbs, since the import from Europe there has been a good deal of both natural and man-inspired selection of those species so that they will be the best growth for the particular area in which they are being grown. Isn't that correct?

A Yes, that's a fair statement.

Q And that's so that the best -- so that man could produce something most suited to its area and most suited to the use which was going to be made of it.

A I'm not sure that I understand your entire question, but I think your latter point that the selection has been for specific uses is fair enough,yes.

Q And the fact that a species imported from Europe which successfully grows a forage crop in Southern Alberta, it doesn't follow how that is going to behave in northern regions. Does it?

A It doesn't exclude it either.

Q But one cannot say that because a type of grass grows a good hay crop in -- at Calgary, it is going to grow well on a pipeline right-of-way near Inuvik.

A That's exactly what I outlined for you when you asked me the objectives of the programs, revegetation programs in 1971. You're quite right, at that point in time we did not know the performance, what the performance of those would be under those conditions.

Q So that Mr. Dabbs, what significance is it that they belong to the same genera which are a natural part of the northern ecosystem? That doesn't help at all if you're going to bring in something which will not survive in a northern region.

A Well, I'm not certain that I understand your question, sir.

MR. MARSHALL: It's related to the all belonging to genera, which are a natural part of ecosystems. The editorial comment is not part of your question, is that the answer?

MR. GIBBS: Q Mr. Dabbs, you say on page 13:

> "Although a number of species proposed for inclusion in the reseeding program are technically imports from Europe, all were introduced into North American 50 to 200 years ago and all belong to genera, which are a natural part of the northern ecosystem."

I understood you to want us to conclude that as they were of the same genera, that meant that they would propogate in the north as well as they do in the south. Was that not your intention?

A No sir, the intent of the statement was to point out that in fact they are closely related to genera that naturally exist, just as the statement reads.

Q It is an interesting point but it isn't necessarily going to apply that it leads to a conclusion that they therefore will grow in the northern areas?

A No, it is to state the fact that anything here used is related genetically to plant material that exists in the north. Nothing more than that.

Q Now, sir do you see, and I am sure your going to say no, but let's put the question to you anyway; any danger that bringing in these species will lead to these species taking over some of the native grasses and replacing them, spreading, invading?

A I think I followed your question but it wasn't clear just what you were asking me and I am trying to cooperate.

Q You said you followed the question?

A Well--

Q Is there a danger of these species that it is planned to introduce, displacing species that are already there?

A That was my understanding. And I would say that on the basis of the argument I have made, I would say the danger is minimal or non-existent.

Q In your experience, Mr. Dabbs, can you relate any instance of this having

happened? An introduced species having invaded and taken over from a native species in the settled areas of western Canada?

A No, I can't, I am afraid myself, come up with an example where it has ever happened.

Q Well, isn't that what has happened in many of the areas with the type of grass called quack grass?

A Quack grass is successful only in disturbed sites, sir. In agricultural fields, roadsides, in your own lawn; that is technically a disturbance in closed natural community.

Q And you have never seen quack grass take over from native cover, only where it has been disturbed?

A I have never seen it dominate, no.

Q Have you seen it plant in a native cover?

A I could say, that I could believe that it can exist in a native community but--

Q And once it establishes itself, it just expands and expands and expands, doesn't it Mr. Dabbs?

A Not in a closed community, not in a closed natural community it doesn't sir. It does if there is some other disturbance, whatever the type of disturbance. That is the reason it has been successful as it is as a weed because the competition of

a closed community has been in some way reduced and it is successful and at that point it expands, yes.

Q And don't you foresee this happening with some of your species which you are going to bring in from the south which don't normally grow here, them taking over in exactly that circumstance where there has been some natural disturbance of the native system?

A They could exist as they currently do and as they have for several decades along disturbed sites, roads, around towns, around airstrips. Yes, they could continue to exist in continued disturbed sites.

Q Now sir later in that paragraph you say, after having spoken of Kentucky bluegrass and meadow foxtail and timothy, you say, "Most are circumboreal or circumpolar in distribution but restricted to disturbed habitats. Red top is never found in Arctic regions but is common in western Canada and has had sufficient time to migrate into Arctic areas if the environment had been suitable". What part of the environment Mr. Dabbs, do you believe to be unsuitable to red top migration?

A I refer here, sir, to the general Arctic and sub-Arctic environment as a whole.

Q Well, do you intend to say that it is too cold for red top?

A In the very northern areas,

the tundra areas, yes sir, it probably is.

Q And you intend in the more southern areas to say it is too wet for red top?

A No, I don't.

Q And why--

A The point I make here sir is that the drainage systems, the Athabaska, the Saskatchewan; all of their river systems are drained eventually into the Mackenzie, have been draining through agricultural lands in west and northwestern Alberta since agricultural activity started. There has been all of the opportunities nature offers to a plant species, to migrate. Particularly that of flowing rivers and streams in the Mackenzie River system itself.

This species and a variety of red top has been used in Alberta for a long time and has not migrated north, it has not displaced any native plant material, plant species from any closed plant community. That's all I said.

Q Well, the central part of your thesis Mr. Dabbs, is that none of these domestic varieties are going to take root and displace native varieties unless it is in a disturbed area. Is that correct?

A That is the only area in which they will be successful.

Q Yes. But hasn't creeping red fescue and slender wheat grass had to come into

these native areas from somewhere other than where they are now found?

A The two that you mentioned sir, festuca rubra, agropyon trachycaulum exist as a natural component of boreal ecosystems and Arctic ecosystems. They have evolved a place in North America.

Q And has the same applied to Kentucky bluegrass, meadow foxtail and timothy ?

A The genus of each of those does exist in northern systems. The particular variety that may be used in itself has not been selected.

Q Well, what I don't understand Mr. Dabbs is why you can say that varieties now used in domestic use in Alberta, for example, are not going to take root or grow in the North, except in disturbed areas, when there appear now to be native grasses which must have come from elsewhere and through a process of selection, and took root and grew and are now native grasses. Why can't that happen again?

THE COMMISSIONER:

Well : is your point that if it were going to happen it would have happened by now. They have had every opportunity that dispersal over the whole continent occurs fairly swiftly and it has-- They don't appear up here yet so you are safe in predicting that if you introduce them here, and they survive it will only be in disturbed areas. Is that what your getting at here?

A Yes, sir I believe that's

a very good summary of conditions.

THE COMMISSIONER: Well, let's stop for coffee. You can carry on afterwards.

(PROCEEDINGS ADJOURNED FOR A FEW MINUTES)

(PROCEEDINGS RESUMED PURSUANT TO ADJOURNMENT)

MR. GIBBS: Sorry, I thought we were proceeding with the film.

THE COMMISSIONER: I think we will carry on if you don't mind, if you are in a position and then we will see the film and then we will be a little farther along.

MR. MARSHALL: We'll tell you when we have the popcorn ready, Mr. Gibbs.

MR. GIBBS: I wonder who is sponsoring this film or whether it is going to be marked as an exhibit.

MR. CARTER: Cut the corn.

THE CHAIRMAN: Come on. Let's get on with it.

MR. GIBBS: Mr. Dabbs, will you turn to page 15 of your prepared evidence please? Do you have it?

WITNESS DABBS: A Yes, sir.

Q By way of preliminary, can you tell me how deep the snow was on the snow road test in 1973-'74?

A On the road itself?

Q Yes.

A We would have to consult the snow road report which gives a very accurate measurement throughout because the depth of snow was slightly different in different locations. For instance, as Mr. Williams has explained to the Inquiry on the grades on the hills, there was a considerably more snow

applied there than on a straight and level. The -- generally, however, and I think that's all you are asking there were the snow pavement itself, the processed snow pavement was approximately six inches thick. It's my recollection and there was another six or eight inches of compacted but not processed snow between the pavement and the tops of any tussocks or mounds.

So there is no one answer to your question because the depth of the snow between mounds could have been a couple feet and it could have been just a foot over the tops of mounds.

Q Well, it would vary between one and two feet in thickness?

A As a general statement without checking the report, I will accept that.

Q You speak in Item 1 with a large decrease in percent of ground cover due to construction and use of the snow road. That decrease in ground cover -- was the ground cover killed or did it grow again after one season?

A Oh, it was not killed. By ground cover that may be a slightly misleading to people who are not familiar with quadra-sampling of vegetation but it's the ground covered by leaves. Those were in many cases knocked off or broken off and the plants that were not killed and those shrubs and have recovered.

Q And so, your conclusion

is that there is no permanent damage then because of that snow road.

A I'm just trying to see exactly whether I used those words or not but there is permanent effects in as much as the trees were removed but there is no damage in my opinion.

Q No, you say there is no significant change in surface elevation, organic layer thickness, or active layer thickness, so . except that the trees are broken there is no lasting damage to the soil or the subsoil?

A That's been our measurement.

Q Would you suggest, Mr. Dabbs, that that test would be representative of what will occur with snow roads throughout the length of the pipeline?

A I think the best I can answer that, sir, is if, as I have worded it here the snow roads are built in a similar inasmuch as they are have been completely protective of ground cover, both living and dead, then I will make the conclusions that I have, whether or not it's applicable to the rest of the route and it would have to be a question posed to someone such as Mr. Williams.

Any descriptions that we have been given, the same type of processed snow road will be used throughout the route in that I would then come to these conclusions.

Q Then the conclusion is restricted to this that if you build a snow road in the same manner, in the same area, you will get the same results?

A My conclusion is that if you build a snow road in the same manner then the results will be the same, not necessarily restricted to the same area.

Q I see. Regardless of where in the length of the pipeline --

A As long as it is built in the same manner.

Q Could you turn now to page 17 of your prepared evidence, please? Where you talk about methanol spills and in Item 1, you refer to 65% damaging effect on vegetation or reduction in plant cover. Again, was that reduction in plant cover due to the plant being killed?

A That measurement was a loss of cover -- ground cover -- of living materials and as the report indicated there is and has been a recovery of that.

Q The full 65% has re-covered again?

A Not the full 65, no, it is slower to recover particularly at this heavier concentration.

Q Well, how much of -- what percentage is permanent damage then from that sample

methanol spill?

A I think that we can conclude permanent damage even yet. I think data that will be presented in a forthcoming report will demonstrate the amount of recovery and that in itself couldn't be concluded as permanent so I'm afraid I couldn't answer -- give you a good answer.

Q Of the reduction of plant cover of up to 65%, how much of that was moss and lichen?

A I would have to consult the report closely to give you an answer. I'm sorry.

Q Did you examine it that carefully to determine whether any moss or lichen was killed by the methanol spill?

A Oh yes.

Q You did.

A Yes.

Q And you say the research is continuing and further results will be presented when available. When do you expect those further results?

A In this case . I am referring to plans for even continued studies this winter so I'm afraid in this case, I couldn't give you an accurate estimate of time when the report would be available.

Q What is the continuing research? Are you going to cause more methanol spills in different areas or are you going to monitor the ones that occurred or that you induced in 1975?

A I think both.

Q I see and what do you anticipate you will learn from more methanol spill?

A The response or effect of methanol on different types of plants, the test I refer to here was in a open black spruce lichen forest area and we want to expand that to other types of -- at least, one or two other types of plant communities.

Q And have you chosen the sites where that will be done?

A I believe they have. I haven't selected them myself but I believe the site has been selected.

Q And the time when it will be done?

A It would be in late winter. The specific time isn't that critical.

Q Are the tests, sir, of general application to the extent that one could say that when you have completed this winter's tests, you will have results which will apply throughout the length of the pipeline?

A I wouldn't think that it would be applicable necessarily to all vegetation types.

Q To all vegetation types, did you say?

A Throughout the length

of the pipeline.

Q Are you selecting certain ones to apply the test to or is it by random, at random that some will not be subject to tests?

A Well, we're interested in the effects on representative areas or areas that are representative of major plant community types at this point in time in the northern areas.

Q But when the results of those tests are available they will be brought to this Inquiry?

WITNESS HEMSTOCK: Yes sir, but as he pointed out, some of the work would not commence until next August.

Q I'm sorry, I didn't hear.

A He pointed out that some of the work would not commence until next March or April, so it would be possibly a year hence before the results would be available.

Q I may not be here a year hence. Would you look at the second last paragraph on page 17, Mr. Dabbs? I take it from that that after telling us about how the domestic varieties of grass will grow on the disturbed areas, nonetheless you're proposing to cultivate and harvest and seed some indigenous varieties of grass cover.

WITNESS DABBS: Well, your statement is fair enough but it doesn't apply to that particular paragraph.

Q Well, I understand the paragraph to read:

> "Many of the varieties found to grow successfully in Northern areas are not grown commercially in large quantities. Consequently Arctic Gas engaged the services of a seed broker to assist us in writing seed multiplication contracts with certified growers."

Doesn't that tell me that you're going to try and

produce enough seed of native varieties to seed the pipeline?

A Well, let's look at the first sentence where I say,

"are not grown commercially in large quantities."

They are grown commercially in smaller quantities and these are the varieties, some of the varieties that have been listed in the specifications which were attached as appendix to my panel 2.

Q Well, Mr. Dabbs, I'm not trying to fence with you. Let me put it this way, do you intend to seed some native varieties on the pipeline right-of-way, is that right?

A Oh yes, sir. That's not what we're talking about in this paragraph.

Q That's what you're talking about in that paragraph, is it?

A That's not what I'm talking about in this paragraph, sir.

MR. MARSHALL: I think they've got two programs.

A Yes.

MR MARSHALL: That's what he gets to. This one he's talking about commercial seeds, and they've got some contracts to get enough quantities. They have another program where they are harvesting native species and they have that under another program, Mr. Gibbs; but your overall point is right that yes, they are trying to gather these.

MR. GIBBS: Well, we are at

one on this, that you are attempting to get together sufficient seed of the native varieties to seed the right-of-way. Is that right?

WITNESS DABBS: That statement is correct with some qualification, in that the native seed we do hope to use is part of the seeding of the right-of-way, yes.

Q And the reason for that is that you don't expect to have enough native seed to reseed the right-of-way, is that right?

A We have no evidence to show that we will have, so were taking a conservative approach.

Q And if you do have, you will, I take it, use the native seed rather than introducing varieties from -- southern domestic varieties.

A Well, sir, the evidence of everyone associated with this research to date would indicate that there is a strong need, an important need for the inclusion of the agronomic varieties as specified.

Q You would propose to introduce those even though you had sufficient native grass seed?

A We are creating a hypothetical scenaric here, the evidence to date, and I make my statements specifically on the basis that the data at hand would show that there is a need for the inclusion of the rapid-establishing agronomic

varieties for purposes of erosion control. That is a fact everyone has before them at the moment. If that fact changes, we would certainly go along with your suggestion.

Q Well then, how do you propose to use the native grasses then if you're going to put in the domestic varieties?

A As mix, either as a mix or as a supplement seeding, as a dressing to areas.

Q Do you expect then, as Dr. Vaartnou does, that the introduced grasses from the southern areas are going to winter-kill either by frost or by disease?

A In time they do when they trundle in the vigour and they're replaced.

Q So that introduction is purely a temporary expedientcy?

A For the reasons and the objectives set, yes sir.

Q Because you want quickly to get a cover to prevent erosion.

A Yes sir.

Q And you don't think that that can be accomplished by seeding native varieties?

A There's no evidence to conclude that.

Q Will you now turn to page 18, please? The first full paragraph you talk about the release of two unlicenced varieties. Would you explain to me the difference between a licenced

and unlicenced variety?

A A licenced variety is one that which has undergone the many years of testing, selection, and has conformed to all the requirements set under regulations to the Canada Seed Act. It's a licencing process laid down by the Department of Agriculture. This is a process that takes many years. There are innumerable unlicenced varieties under test that's the objective of many people in the Department of Agriculture in plantbreeding programs, a long process of testing, in some cases results in the culmination of a licencing of a variety for commercial production and sale in Canada. An unlicenced variety is one that has not undergone that same testing.

Q Does it imply that by the time it has become a licenced variety that there are large quantities available?

A Oh no.

Q And do you propose to use some of those two licenced varieties for revegetation?

A Sorry, in your question you said "those two licenced varieties".

Q Well, the two you referred to.

A Unlicenced varieties.

Q Well, when you say "the release of these varieties" you're not implying that they will now become licenced?

A No, they have not become licenced for the purposes I've described, and yes, we

propose to use them as they have now been released for this application by the Department.

Q They have been released although they are not licenced?

A Yes, the licencing is quite a-- for different purposes, sir.

Q I see, and you propose to use some of those in your revegatation program.

A Yes.

MR. GIBBS: That's all, thank you, sir.

MR. MARSHALL: It's now a quarter past four, sir, and I wonder if we might have the film to conclude our day?

THE COMMISSIONER: All right.

MR. MARSHALL: Fine, Dr. Gunn?

WITNESS GUNN: Mr. Commissioner, this film was prepared about two years ago and it describes the biological research that was carried on for Arctic Gas by the consultants. It is a public relations film so there are a few pro-pipeline statements in it which you can recognize and disregard, but basically it's very low key, it doesn't stress that as m any public relations films do, and I think it does provide a very good overview of the experimental work, particularly the disturbance tests.

I suggest, sir, that you'd better come and sit back here so you can see.

(FILM PRESENTATION)

(PROCEEDINGS ADJOURNED TO NOVEMBER 19,1975)